

**QUALITY MEASUREMENT OF POPULAR
INSTANT MESSENGER APPLICATION
BASED ON NIESLEN SURVEY USING
ISO 9126-1 QUALITY MODEL
(CASE STUDY: BLACKBERRY MESSENGER,
WHATSAPP, AND LINE)**



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**GRADUATE DEGREE
GUNADARMA UNIVERSITY
JAKARTA
2015**

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THESIS

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ABSTRACT

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QUALITY MEASUREMENT OF POPULAR INSTANT MESSENGER APPLICATION BASED ON NIELSEN SURVEY USING ISO 9126-1 QUALITY MODEL (CASE STUDY: BLACKBERRY MESSENGER, WHATSAPP, AND LINE)

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Instant messenger application has a function to exchange messages in lieu of the role of SMS (Short Message Service). According to Nielsen On Device Meter (ODM), majority of Indonesian smartphone users chatting using BlackBerry Messenger (79%), WhatsApp (57%), and LINE (30%). The quality of each application is measured to determine and prove that the popularity of BlackBerry Messenger (BBM), WhatsApp, and LINE synch with its quality. Quality measurement of the application is done by weighting through the Analytic Hierarchy Process (AHP) method on BPMSG AHP Priority Calculator tools and measurement standards ISO 9126-1 Quality Model. Based on test results, quality of the popular instant messenger applications have been a good performance with the sequence of WhatsApp (93%), LINE (92%), and BlackBerry Messenger (90%). It's proves that the popularity of them is not synch with its quality.

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CURRICULUM VITAE

Nur Fisabilillah was born in Jakarta on April 30th, 1992. Author graduated the elementary school in SDN Jatikramat VII Bekasi on 2004, junior high school in SMP IT IQRO' Bekasi on 2007, and senior high school in SMAN 5 Bekasi on 2010. After that, author continued to Gunadarma University majoring in Information System. In 2011, author got SarMag (Sarjana Magister) Scholarship Program from Gunadarma University. Author graduated in 2014 with research's title "THE OPTIMALIZATION OF PARKING TICKETING SYSTEM USING QR CODE GENERATOR AND READER (CASE STUDY: INPRES MARKET PONDOK BAMBU)". After that, author continued to magister management of information system, concentrated in business information system.

PREFACE

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The title of this thesis is QUALITY MEASUREMENT OF POPULAR INSTANT MESSENGER APPLICATION BASED ON NIELSEN SURVEY USING ISO 9126-1 QUALITY MODEL (CASE STUDY: BLACKBERRY MESSENGER, WHATSAPP, AND LINE), which is structured as a prerequisite for completing the program or graduate degree (S2) in Business Information Systems Studies Program at Gunadarma University.

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1 INTRODUCTION

1.1 Background

The existence of smartphone closely related to user routine in the world as the development of smartphone offered by every smartphone vendor. User may feel worry if their smartphone is not with them. Such condition occurs because of smartphone role which serves as friendly and fast performance communication gadget connected to another user. According to Indonesia Smartphone Consumer Insight survey result on May 2013 shows that the most-often doing activity done by smartphone user in Indonesia is chatting, either through SMS or Instant Messenger application, with percentage of 90%. [1].

It cannot be denied that the role of SMS to send message has been shifted to Instant Messenger application, either for private or business usage. This is caused by the efficiency of using Instant Messenger application on communication process. According to Nielsen On Device Meter (ODM) survey, there are three Instant Messenger applications that mostly used by smartphone user in Indonesia, i.e BlackBerry Messenger (79%), WhatsApp (57%) and LINE (30%) [2]. Time spent on chatting using Blackberry Messenger spends about 23.3 minutes, WhatsApp for 2 minutes, and LINE for 5.1 minutes within a day [2]. Those three Instant Messenger application have several same and different features.

The quality of Instant Messenger application such as BBM, WhatsApp, and LINE is visible through all of the well-functions. However, the rating of quality is

important to be done by developer to measure the suitability of usage toward the productivity of application. The rating is also a primary focus on fulfill the standard of international measurement, so that the quality of those three instant messenger applications can be measured. This rating is held to find bugs on application and to create a better one. Additionally, the rating is held to prove the rank of quality from those three applications corresponding to the amount of user in Indonesia.

On the previous research [3], a test to information system of academic in STMIK Pranata Indonesia has been conducted using standard ISO 9126. The test measured the success level of utilization of information system of academic and produced rating description of quality of the developed system had been running well [3]. The quality measurement of the three instant messenger will be measured using 6 characteristics of ISO 9126-1 Quality Model as well as the previous study. Each of characteristic has criteria, such as functionality, reliability, usability, efficiency, maintainability and portability. ISO 9126-1 Quality Model is the most suitable for quality measurement of Instant Messenger application. Weighting of characteristic and sub-characteristic sorting uses AHP on BPMSG AHP Priority Calculator. AHP method is considered to be used because of its ability to produce main priority between criteria with hierarchy structure. Several characteristics on quality measurement of the three most popular applications will be conducted through observation and questionnaire.

1.2 Identification of Problem

Based on the background, the identified problem are as follows:

1. Do the popularity of BlackBerry Messenger (BBM), WhatsApp, and LINE balance with their quality as a software?
2. How accurate is the weighting of each characteristic and sub-characteristic calculated using AHP?
3. Is standardization of ISO 9126-1 Quality Model right to use on quality measurement of the three most popular instant messengers?

1.3 Scope of Problem

Based on the identification of problem, the scope of problem are as follows:

1. The population used is smartphone Android user in Indonesia that use BlackBerry Messenger (BBM), WhatsApp, and LINE with smartphone screen < 5 inch.
2. Weighting of characteristic and sub-characteristic ISO 9126-1 Quality Model uses AHP on BPMSG AHP Priority Calculator. The weight is collected from the questionnaire result with 30 respondents that has background of technology.
3. Observation is conducted on Functionality, Reliability, Efficiency, Maintainability, and Portability.
4. Questionnaire is conducted on Usability characteristic to 204 respondents using Simple Random Sampling technic, Slovin Sample Formula, and level error of sample measurement with 10%.

5. Data analysis uses validity and reliability test using SPSS 20.
6. Software quality model uses ISO 9126-1 Quality Model. On Maintainability characteristic, only Analyzability and Maintainability Compliance sub-characteristics are used to measure the quality of the three most popular instant messengers.

1.4 Formulation of Problem

Based on the background, the formulation of problem are as follows:

1. How to determine the weight of each characteristic and sub-characteristic ISO 9126-1 Quality Model on quality measurement of BlackBerry Messenger (BBM), WhatsApp, and LINE?
2. How is the quality of the three most popular instant messengers tested based on ISO 9126-1 Quality Model?
3. How to measure the suitability of quality of the three instant messengers to the amount of user in Indonesia?

1.5 Research Purpose

Based on the background and formulation of problem, the research purposes are as follows:

1. Obtaining accurate weight value from each of characteristics and sub-characteristics, so that the result of test will be actual and trustworthy.

2. Finding out the value of Functionality, Reliability, Usability, Efficiency, Maintainability, and Portability to operating performance of the applications.
3. Proving and ensuring that the quality of the three most popular instant messenger has met the international standard and consistent with their popularity ranking.

1.6 Research Usability

This research is expected to be helpful for all parties, not only theory usability but also practice usability. Theory usability of this research is reserved for development of science. With this research, the insight about software quality based on ISO 9126-1 Quality Model, especially Instant Messaging, can be further expanded. Furthermore, this research is expected to contribute innovative and creative idea. It can be input for the development of science to develop a range of aspects that have not been met.

As for practice usability that benefits for developer and user. For developer, the result of quality measurement could provide feedback to user's respond. The feedback could be an improvement for developer to develop their application better. While for user, they could know factors that support the used instant messengers. The knowledge may be a consideration for user to choose instant messenger much wiser based on their needs.

2 LITERATURE REVIEW

2.1 Development of Instant Messenger

Instant Messenger (IM) is one of direct communication in the form of typed text between two or more people. Instant messenger is also a software that provides the facility of sending instant messaging. Instant messaging of GUI-based (Graphical User Interface) begins when the use of online technologies are widely used in early 1990. The rapid growth of internet communication makes software developers to develop a software chat room, including the Quantum Link online service providers better known as America Online (AOL). These providers offer features to exchange messages to other computer users who are in the state online. The development is being conducted by the developer to make instant messenger began much in demand on the internet in November 1996. It is characterized by the emergence of the Mirabilis that introduce ICQ as free instant messenger that can be used by everyone. In 1997, AOL Instant Messenger (AIM) following in the ICQ trail and acquired Mirabilis. [4]

The presence of instant messenger that can currently be accessed via computers and smartphones make instant messenger progressed very rapidly. From the start the instant messenger software, like mig33, Nimbuzz, and eBuddy, until the appearance of BlackBerry Messenger, WhatsApp, and LINE that more pamper users to display user-friendly. Role instant messenger to communicate and interact with each other feel the benefits for the private usage, such as meeting information, parent news, absent of the lecturer news, sad news, and so on. Meanwhile, the

booming of instant messenger application are used by businesses to increase their income and business services. Examples of the use of instant messenger is a marketing activity, promotions, branding image, as well as intensive communication to customers. No wonder the instant messenger application into one of the mobile software that is most in demand by a variety of existing variants. Typically, the user selects an instant messenger application because of the many other users who use the application. The features of group chat, sending pictures, voice message, voice call, or video call is an added value chosen by the user to use it. Not only that, good quality and diverse features be considered by the user to select it. The security system of any instant messenger application also needs to be known in order to avoid aberration and abuse of user accounts.

2.2 Instant Messenger Applications of Android-Based

Instant messenger can be accessed via smartphones has now grown rapidly from variety of existing mobile platforms, including Android. Almost all smartphone vendors already producing Android-based smartphone. The vendors are Samsung, Sony, LG, HTC, Motorola, Asus, Xiaomi, Acer, IMO, and much more. It's because Android is an open source operating system for Linux-based mobile devices that includes an operating system, middleware, and applications [5]. The character that open source produces the variants of instant messenger applications developed by developers. They are BlackBerry Messenger (BBM), WhatsApp, LINE, WeChat, Kakao Talk, Google Hangouts, Skype, and others.

2.2.1 BlackBerry Messenger (BBM)

BlackBerry Messenger (BBM) is an instant messenger application developed by BlackBerry Limited, formerly known as Research In Motion (RIM) Limited. Initially BBM can only be used by the BlackBerry OS users. At the end of 2013, BBM officially released for Android and iPhone OS users. BlackBerry Messenger (BBM) logo can be seen in Figure 2.1.



Figure 2.1 BlackBerry Messenger Logo [6]

With BBM, chat in real-time with BBM contacts and groups can be done by the user. Users can update your BBM status or display picture (DP), share photos, to know that someone has read or is typing a reply message. In addition, users can also share news with some people through a multiperson chat, group chat, and broadcast messages. BBM can access through internet data packets on a 4G/3G/2G/EDGE or Wi-Fi. As for the features to support Android-based BBM application is described in Table 2.1. [6]

Table 2.1 Features of Android-based BlackBerry Messenger (BBM) [6]

Features	Description
BBM Profile	Select the display picture (DP), username, and status that can be seen by people in the user's contacts. BBM PIN can also be seen by user through the display QR Code.
Invite	Invite people to chat with each other by: <ol style="list-style-type: none"> Scanning BBM QR Code, Using Near Field Communication (NFC) technology, if supported by the device, or Entering a phone number, email, or BBM PIN.
Chat	Sharing the experience of using instant messaging, pictures, voice notes, and files.

Emoticons	Express yourself with various classic BBM emoticons and sticker that has been provided in the BBM Shop.
BBM Groups	Plan events, track to-do lists, share pictures, and chat with up to 50 friends, family, or coworkers in one group at the same time.
Broadcast Messages	Send a message to multiple contacts at once.
BBM Channels	Share your thoughts, ideas, and passion. Join the conversations that are happening with other people who have similar interests.

Measuring the quality of BBM applications will use 2.8.0.21 version that the last updated on 24 April 2015 by Google Play Store. In this version, the BBM application has been supporting the Android 5.0 Lollipop. In addition, this application has been able to start chatting with address book contacts who are already using BBM application, a broadcast message may be sent to specific categories, and can block receiving messages from a multi-person chat. [7]

2.2.2 WhatsApp Messenger

WhatsApp Messenger is a cross-platform mobile messaging application to exchange messages without having to pay for SMS that developed by WhatsApp Inc. WhatsApp Messenger is available for Android, iPhone, BlackBerry, Windows Phone, and Nokia. WhatsApp word is a play on What's Up, which means in Indonesian is “Apa Kabar”. WhatsApp was founded by two people, Jan Koum and Brian Acton, which has a total experience in conducting various technical terms in Yahoo! Inc for 20 years. In 2014, technology companies founded in Silicon Valley have been acquired and ownership WhatsApp Messenger is held by Facebook Inc. WhatsApp Messenger is developed to create a better alternative than SMS because it is expected that everyone will have a smartphone [8]. WhatsApp Messenger logo can be seen in Figure 2.2.



Figure 2.2 WhatsApp Messenger Logo [8]

WhatsApp Messenger can be used via the internet data packets on a 4G/3G/2G/EDGE or Wi-Fi network if available. In the first year of use, WhatsApp can be used free of charge and paid annually for \$ 0.99 USD after the first year of usage time has expired. As for the features to support Android-based WhatsApp application is described in Table 2.2. [9]

Table 2.2 Features of Android-based WhatsApp Messenger [9]

Features	Description
WhatsApp Profile	Select profile photo, username, and status that can be seen by other users.
Chat	Sharing the experience of using instant messaging, pictures, video, audio, voice message, location, and contacts to friends around the world are integrated with the user's smartphone contacts.
Emoticons	Express yourself with a variety of simple emoticons that have been provided.
Chat Groups	Enjoy group conversations up to 100 friends, family, or coworkers in one group at the same time.
Broadcast Messages	Send instant messages, pictures, video, audio, voice messages, locations, and contacts up to 256 members in one group at the same time.
Contact	The address book will be connected automatically with contacts who use WhatsApp Messenger.

Measuring the quality of WhatsApp Messenger applications will use 2.12.5 version which the last updated on 30 April 2015 by Google Play Store. In this version, WhatsApp Messenger has provided feature of WhatsApp Web to exchange messages on a user's computer browser by visiting web.whatsapp.com. In addition, this application has provided WhatsApp Calling feature, so that users can make free calls using the telephone internet connection. [9]

2.2.3 LINE Messenger

LINE is an instant messenger application that originated in Japan and was developed by Naver. LINE was launched on June 23, 2011 and experienced growth in 2012 due to a variety of interesting sticker. Until 2014, LINE has become a popular application to have 300 million users worldwide. Many users who like LINE as interpersonal communications media because of LINE has \pm 10,000 sticker attractive, both paid and free. Sticker concept created by LINE shows funny expression and idol from various circles, such as sticker of actor Joe Taslim, singer Bunga Citra Lestari, and movie player “Ada Apa dengan Cinta (AADC)” [10]. LINE Messenger logo can be seen in Figure 2.3.



Figure 2.3 LINE Messenger Logo [11]

Communications application that provides free voice calls has become the first rank of applications most frequently downloaded in 52 countries, including Indonesia. LINE Messenger is available for Android, iPhone, BlackBerry, Windows Phone, and Nokia. In addition, LINE Messenger is also available on the personal computer (PC). LINE Messenger can be used via the internet data packets on a 4G/3G/2G/EDGE or Wi-Fi network if available. As for the features to support Android-based LINE application is described in Table 2.3. [11]

Table 2.3 Features of Android-based LINE Messenger [11]

Features	Description
LINE Profile	Select the profile pictures, username, user ID, and status that can be seen by people in the user's contacts. User ID can also be seen through the display QR Code users.
Add Friends	Add a person to chat with each other by: 1. Invite friends via SMS, email, or share the QR Code. 2. Scanning QR Code LINE, or 3. Using features Shake It! or LINE ID.
Chat	Sharing the experience of using instant messages, pictures, videos, voice messages, locations, and contacts to friends around the world.
Free Calls and Video Calls	Make a phone call or video to communicate with friends and family in far away places or hold business meetings. This feature is only available on Android and iPhone devices.
Emoticons	Express yourself with various cute and funny emoticons and sticker which shows the famous characters from all over the world via the Sticker Shop.
Chat Groups	Enjoy group conversations with friends, family, or coworkers in one group at the same time.
Official Account	Add Official Account to receive official messages of celebrities in the country of the user's choice.
Timeline	Share text, pictures, videos, and stickers along with friends.

Measuring the quality of LINE Messenger application will use the 5.1.2 version which the last updated on 21 April 2015 by Google Play Store. In this version, LINE Messenger provides a design update to the profile thumbnail, the addition of a new photo filter, adding to Favorites group, sending a notification to the chat when a new post is added, and the addition ycon to the chat's "+" menu. [11]

2.3 Software Quality Assurance (SQA)

According to IEEE Glossary, Software Quality Assurance (SQA) is a planned and systematic pattern of all actions necessary to provide adequate confidence that

an item or product conforms to established technical requirements. Software Quality Assurance (SQA) is also a set of evaluation activities designed to develop or produce a product. SQA is based on the planning and implementation of various measures which are integrated into all the stages of the software development process. This is done to support the user confidence that the software product will meet all the technical requirements. Despite its emphasis on planning and systematic implementation, SQA scope doesn't include maintenance, timetable, and budget issues. The expanded SQA definition in accordance with the standards basic concept of the existing quality models. [12]

SQA activities refer to the functional, managerial, and economic aspects of software development and maintenance. It is performed to prevent, detect, and correct the cause of the error. These objectives can be seen from the aspects as follows [12]:

1. Software Development (Process-Oriented):
 - a. Assuring an acceptable level of confidence that the software will conform to functional technical requirements.
 - b. Assuring an acceptable level of confidence that the software will conform to managerial scheduling and budgetary requirements.
 - c. Initiating and managing of activities for the improvement and greater efficiency of software development. This means improving the prospects that the functional and managerial requirements will be achieved while reducing the costs of software development and SQA activities.

2. Software Maintenance (Product-Oriented):
 - a. Assuring with an acceptable level of confidence that the software maintenance activities will conform to the functional technical requirements.
 - b. Assuring with an acceptable level of confidence that the software maintenance activities will conform to managerial scheduling and budgetary requirements.
 - c. Initiating and managing activities to improve and increase the efficiency of software maintenance and SQA activities. This involves improving the prospects of achieving the functional and managerial requirements while reducing costs.

2.4 Quality Models

Software Quality Assurance (SQA) has some choice models that can be used to measure software quality assurance. Generally, software quality have the identification as follows [13]:

1. **Conformance to Specification:** Quality is defined as matter of products and services whose measurable characteristics satisfy a fixed specification.

2. Meeting Customer Needs: Quality of identified independent of any measurable characteristics. It's defined as the products or services capability to meet customer expectations explicitly or not.

Quality model that has international standards can be used as a reliable reference for the process of measuring the software quality is done. Quality model of international standards and the most commonly used among others McCall's Quality Model (1977), Boehm's Quality Model (1978), and ISO 9126's Quality Model (2001) [13].

2.4.1 McCall's Quality Model (1977)

Founder of famous quality models that are still current quality models is a model of quality presented by Jim McCall (also known as the General Electrics Model of 1977). McCall's Quality Model attempts to bridge the gap between users and developers by focusing on a number of software quality factor that reflect both the user views and developer priorities. This model is derived from the US military (developed for the US Air Force, promoted within DoD) and aimed towards the system developers and system development process. [13]

McCall's Quality Model has three major perspectives to define and identify the quality of software products, including product revision, product transition, and product operations. Product revision is the ability to undergo changes, product transition is the adaptability to new environments, and product operating is the ability to operate the product. Product revision includes maintainability, flexibility,

and testability. Product transition is all about portability, reusability, and interoperability. Meanwhile, the quality of product operations related to correctness, reliability, efficiency, integrity, and usability. [13]

On McCall's Quality Model, as shown in Figure 2.4, three types of quality characteristics (major perspectives) specified in a hierarchy of factors, criteria, and metrics as follows [13]:

- a. **11 Factors (to specify):** Describing the external view of the software, as seen by the users.
- b. **23 Quality Criteria (to build):** Describing the internal view of the software, as seen by the developer.
- c. **Metrics (to control):** Defined and used to provide the scale and method for measurement.

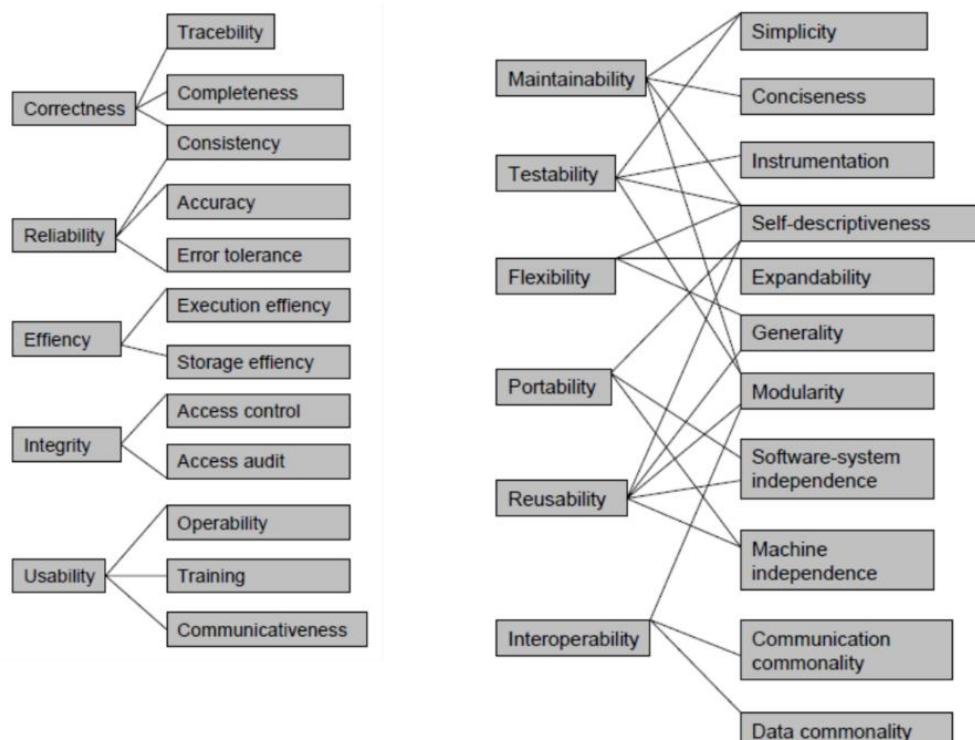


Figure 2.4 McCall's Quality Model [13]

The quality model of McCall in Figure 2.4 explained that the hierarchy of 11 quality factors on the left hand side and 23 quality criteria on the right hand side. The idea behind McCall's Quality Model is quality factor should give an idea software quality completely. [13]

2.4.2 Boehm's Quality Model (1978)

Boehm's Quality Model is a quality model presented by Barry W. Boehm in 1978 to discuss the contemporary shortcomings of models that automatically and quantitatively evaluate the quality of software. Boehm's Quality Model is similar to McCall's Quality Model in that it also presents structured hierarchy. Consequently, this model tries to determine the software quality is based on a set of attributes and metrics [13]. Boehm's Quality Model can be seen in Figure 2.5.

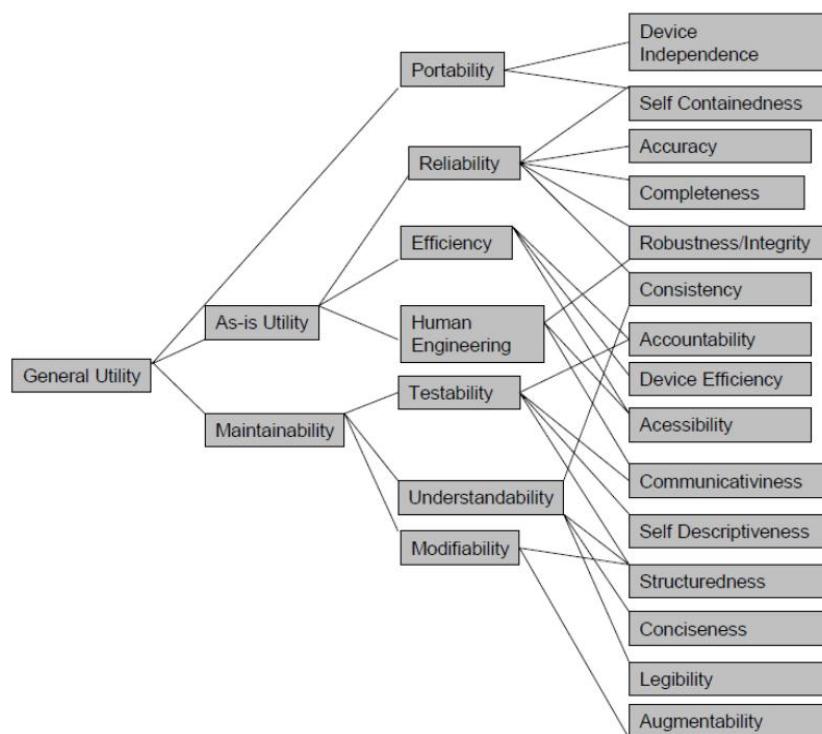


Figure 2.5 Boehm's Quality Model [13]

The model shown in Figure 2.5 has a characteristic levels from high to low-level characteristics. The high-level characteristics represent basic high-level requirements of the actual use to evaluate the software quality. The high-level characteristics address three main questions that are usually asked by a buyer of the software, such as [13]:

1. **As-is Utility:** How well (easily, reliably, efficiently) can I use it as-is?
2. **Maintainability:** How easy is it to understand, modify, and retest?
3. **Portability:** Can I still use it if I change my environment?

Mid-level characteristics have seven Boehm quality factor representing the expected quality of a software system. Seventh Boehm quality factor is as follows [13]:

1. **Portability (General utility characteristics):** Code possesses the characteristic portability to the extent that it can be operated easily and well on the computer configurations other than its current one.
2. **Reliability (As-is utility characteristics):** Code possesses the characteristic reliability to the extent that it can be expected to perform its functions.
3. **Efficiency (As-is utility characteristics):** Code possesses the characteristic efficiency to the extent that it fulfills its purpose without waste of resources.
4. **Usability (As-is utility characteristics, Human engineering):** Code possesses the characteristic usability to the extent that it is reliable, efficient, and human-engineered.

5. **Testability (Maintainability characteristics):** Code possesses the characteristic testability to the extent that it facilitates the establishment of verification criteria and supports the performance evaluation.
6. **Understandability (Maintainability characteristics):** Code possesses the characteristic understandability to the extent that its purpose is clear to inspectors.
7. **Flexibility (Maintainability characteristics, modifiability):** Code possesses the characteristic modifiability to the extent that it facilitates the incorporation of changes, once the nature of the desired changes have been determined.

The lowest level structure of the hierarchy in Boehm's Quality Model is the primitive characteristics metrics hierarchy. Primitive characteristics provide the foundation for defining qualities metrics which was one of the goals when Boehm constructed his quality model. Though Boehm and McCall have similarities, Boehm's Quality Model is more focused on the models effort on software maintenance cost-effectiveness. [13]

2.4.3 ISO 9126's Quality Model (2001)

International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) has established ISO / IEC standards related to software quality. ISO 9000 is the first time that has three guidelines for implementing ISO 9001 standards relating to quality assurance processes. This process is done for the development, supply, installation, and maintenance of

computer software. Then, the standard ISO / IEC 9126 is set for the quality of software products and standard ISO / IEC 14598 for the evaluation of software products. Other standards that can be used in conjunction with ISO / IEC 9126 and ISO / IEC 14598 are [14]:

1. ISO / IEC 12119 - Requirements for the quality of software package.
2. ISO / IEC 12207 - Software life cycle process.
3. ISO / IEC 14143 - Software measurement.
4. ISO / IEC 15 271 - Guide for ISO / IEC 12207
5. ISO / IEC 15504 - Assessment process software (also known as SPICE - Software Process Improvement for Capability Determination).
6. ISO / IEC 15 939 - Process measurement software.

Standard of ISO / IEC 9126 makes a distinction between internal quality and external quality. These model categorize software quality attributes into characteristics. Attributes that can be measured during the development process is referred to as internal. Meanwhile, the external behavior can be measured during the testing process and the quality of the user view [14]. ISO / IEC 9126 consists of four parts which include ISO 9126-1 Quality Model, ISO 9126-2 External Metrics, ISO 9126-3 Internal Metrics, and ISO 9126-4 Quality in Use Metrics [13].

ISO 9126-1's Quality Model defined by the common characteristics of software, which is further refined into subcharacteristics, which in turn is decomposed into attributes and generate a multilevel hierarchy. The main idea behind this standard is the definition of quality model and its use as a framework

for software evaluation. ISO 9126-1 Quality Model of 2001 version has 6 characteristics and 27 subcharacteristics are described in Table 2.4. [14]

Table 2.4 ISO 9126-1's Quality Model [14]

Characteristics	Subcharacteristics
Functionality	Suitability Accuracy Interoperability Security Compliance Functionality
Reliability	Maturity Fault Tolerance Recoverability Reliability Compliance
Usability	Understandability Learnability Operability Attractiveness Usability Compliance
Efficiency	Time Behaviour Resource Utilization Efficiency Compliance
Maintainability	Analyzability Changeability Stability Testability Maintainability Compliance
Portability	Adaptability Installability Coexistence Replaceability Portability Compliance

In the version 2001, there are additional subcharacteristics Compliance at every ISO 9126-1 Quality Model characteristics. The standard of ISO 9126-1's Quality Model characteristics are explained as follows:

1. **Functionality:** The ability of software to provide functionality according to user requirements when used in certain conditions.

2. ***Reliability***: The ability of the software to maintain the performance level when used in certain conditions.
3. ***Usability***: The ability of software related to the use of software that is done by the user.
4. ***Efficiency***: The ability of the software to provide an appropriate performance level and the amount of resources used when the software is run.
5. ***Maintainability***: The ability of the software that is related to the effort required to be modified or changed.
6. ***Portability***: The ability of the software to be sent to a different environment or one environment to another.

ISO 9126 standard was based on the McCall and Boehm quality model. ISO 9126 also includes functionality as a parameter and identifying both internal and external quality characteristics of software products. The comparison of quality models based on their characteristics described in Table 2.5. [13]

Table 2.5 Comparison of McCall, Boehm, and ISO 9126 Quality Model [13]

Characteristics Quality	McCall (1977)	Boehm (1978)	ISO 9126 (2001)
Functionality			*
Correctness	*		Functionality
Reliability	*	*	*
Efficiency	*	*	*
Integrity	*	Reliability & Human Engineering	Security
Usability / Human Engineering	*	*	*
Maintainability	*	*	*
Testability	*	*	Maintainability
Flexibility	*		
Portability	*	*	*
Reusability	*		Portability

Characteristics Quality	McCall (1977)	Boehm (1978)	ISO 9126 (2001)
Interoperability	*		*
Understandability		*	Usability
Modifiability		*	Maintainability

Table 2.5 explains that the most comprehensive quality model is ISO 9126's quality model of 2001 version. McCall models do not analyze the characteristics of functionality, understandability, and modifiability. Boehm models do not analyze the characteristics of functionality, correctness, flexibility, reusability, and interoperability. Meanwhile, the ISO 9126 models do not analyze the characteristics of flexibility only. Therefore, quality assurance measurements of the third instant messenger applications (BlackBerry Messenger, WhatsApp, and LINE) uses the most complete standards and appropriate with the application requirements, namely ISO 9126 standards.

2.5 Method of Determining Weight

The weights are usually determined to obtain a sequence of criteria ranging from the level of the most prioritized to the lowest level. Weighting is done to facilitate decision making using existing methods. Of the many weighting methods, two of which are Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW).

2.5.1 Analytical Hierarchy Process (AHP)

Analytical Hierarchy Process (AHP) is a decision-making model developed by Thomas L. Saaty in 1980. This model has been successfully applied to a variety of decision-making situations. AHP does not only act as the sole decision maker to choose the most suitable alternative, but expanded also to group decision making. AHP will unite decision maker's preference rating for each decision alternative under each criterion in the decision hierarchy. Steps to obtain a decision in AHP are [15]:

1. Decompose the problem in the hierarchical structure decision, including all the criteria, sub-criteria, and decision alternatives.
2. Conduct pairwise comparisons of all decision alternatives under each criterion based on preference rating Saaty scale described in Table 2.6.

Table 2.6 Intensity of AHP Pairwise Comparison [15]

Intensity	Definition	Explanation
1	Equal Importance	Both elements have the same effect is important.
3	Moderate Importance	Elements that one a little more important than other elements.
5	Strong Importance	Elements which one is more important than other elements.
7	Very Strong Importance	Elements of the much more important than other elements.
9	Extreme Importance	One element is absolutely more important than other elements.
2, 4, 6, 8	Representing the values of the intermediate between the two elements.	
Reverse	If activity i got one point compared with activity j , then j has the opposite value compared with i .	

3. Derive the weight of local priority using the eigenvector method or other approximation methods.

4. Synthesize the weight of local priority to produce the overall weight of preference for each decision alternative.
5. Check the inconsistency level of the decision maker's pairwise comparisons. If the level of inconsistency is unacceptable, the decision makers should revise the pairwise comparisons (see Step 2).

To conduct pairwise comparisons of all relevant criteria, Saaty proposed the formulation of $n \times n$ pairwise comparisons matrix $A = \{a_{ij}\}$. Matrix A has a_{ij} values in accordance with the scale of assessments presented in Table 2.6. [15]

$$A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{pmatrix} \quad (2.1)$$

Matrix A is positive reciprocal matrix where the element a_{ij} is defined as the ratio of the preferences of alternative i over the preferences of alternative j . The value of element a_{ij} is the inverse of a_{ji} [15]:

$$a_{ji} = \frac{1}{a_{ij}} \quad (2.2)$$

All diagonal elements assumes a value of 1. If all pairwise comparisons rankings are consistent, then the element a_{ij} in the matrix A will meet [15]:

$$a_{ij} \times a_{jk} = a_{ik}; \quad \text{for all } i, j, k. \quad (2.3)$$

The main component of AHP is a derivation of relative priority weights $\{w_i\}_{i=1}^n$ in the pairwise comparison matrix A. Elements of the vector w is the final priority weight is given to the criteria or alternative i . Note that $\sum w_i = 1$. AHP

propose using eigenvector method, which apply the principle of normalization eigenvector A. It can lower the relative priority weighting vector w . If the value of the matrix A is consistent and satisfies the equation 2.3, then a_{ij} can be expressed as $\frac{w_i}{w_j} = a_{ij}$, for the entire value of i and j , so result in the equation as follows [15]:

$$A \times W = \begin{pmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \dots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & \dots & \frac{w_2}{w_n} \\ \frac{w_1}{w_2} & \frac{w_1}{w_2} & \dots & \frac{w_1}{w_n} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \dots & \frac{w_n}{w_n} \end{pmatrix} \times \begin{pmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{pmatrix} = n \times \begin{pmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{pmatrix} \quad (2.4)$$

The system of equations 2.4 shows that the total number of criteria / alternatives (n) is the eigenvalue of the pairwise comparison matrix A and vector of priority weights $\{w_i\}_{i=1}^n$ is the right eigenvector that corresponds to the eigenvalue n . This proves that n is the maximum eigenvalue of matrix A, thus result in the equation as follows [15]:

$$A \times W = n \times W; \quad W = (w_1, w_2, \dots, w_n) \quad (2.5)$$

To simplify the calculations, Saaty proposed several methods of approach to obtain the relative priority weight vector w by using the method of normalization additive. With additive normalization method is the simplest, the relative priority of the weight vector can be calculated as follows [15]:

$$a'_{ij} = \frac{a_{ij}}{\sum_{j=1}^n a'_{ij}}; \quad i, j = 1, 2, \dots, n \quad (2.6)$$

$$w_{ij} = \frac{1}{n} \sum_{j=1}^n a'_{ij}; \quad i = 1, 2, \dots, n \quad (2.7)$$

Consistency Index (CI) and Random Index (RI) is determined to develop a quantitative measure of the inconsistencies level in the pairwise comparison matrix A by the equation as follows [15]:

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (2.8)$$

$$RI = \frac{1.98 \times (n-2)}{n} \quad (2.9)$$

CI measure the level of inconsistency A, namely the difference between λ_{max} and n are adapted to the dimensions of matrix A. RI measuring the inconsistency level of pairwise comparison matrix dimension n whose elements are randomly generated. The Consistency Ratio (CR) to measure quantitatively the inconsistency level of pairwise comparison matrix by the equation as follows [15]:

$$CR = \frac{CI}{RI} \quad (2.10)$$

If the value of CR more than 10%, the CR is not eligible and are considered inconsistencies. It makes the decision-makers must re-evaluate pairwise comparison rankings. Thus, pairwise comparison of matrix A considered consistent if the value of $CR \leq 0.10$. [15]

2.5.2 Simple Additive Weighting (SAW)

Simple Additive weighting (SAW) is one method used in the decision support system to seek a weighted summation of the performance assessment. The assessment comes from each alternative on all attributes. SAW method is more

focused in assessing more precisely. It is based on the value of the criteria and preference weighting that have been specified. In addition, SAW can also select the best alternative from a number of alternatives that exist because of the ranking process after determining the weight value for each attribute. [16]

SAW method requires a process of normalizing the decision of matrix x to a scale which can be compared with existing alternative assessment rating. The normalization process is performed by the equation as follows [16]:

$$r_{ij} = \begin{cases} \frac{x_{ij}}{\max x_{ij}}, & \text{if } j = \text{benefit} \\ \frac{i}{\min x_{ij}}, & \text{if } j = \text{cost} \end{cases} \quad (2.11)$$

Where:

r_{ij} : Value of normalized performance of alternatives A_i on attribute C_j

$(i = 1, 2, \dots, m \text{ and } j = 1, 2, \dots, n)$

x_{ij} : Value attributes possessed of each criterion

$\max x_{ij}$: The largest value of each criterion

$\min x_{ij}$: The smallest value of each criterion

If the value r_{ij} known, the preference value for each alternative (V_i) is calculated by the equation as follows [16]:

$$V_i = \sum_{j=1}^n w_j r_{ij} \quad (2.12)$$

Where:

V_i : Ranking for each alternative

w_j : Weight value of each criterion

The selection step using Simple Additive Weighting (SAW) method are as follows [16]:

1. Give the value of each alternative (A_i) in each criteria (C_j) that have been determined. Value $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$.
2. Give the weight value (w) obtained from crisp values.
3. Normalize the matrix by calculating the rating value of normalized performance (r_{ij}) of alternative A_i of attributes C_j based on equations that are customized to the type attribute of benefit = MAXIMUM or attribute of cost = MINIMUM).
4. If r_{ij} is benefit attribute, then the crisp values (x_{ij}) of each column attribute divided by the maximum value of crisp ($\text{Max } x_{ij}$) of each column. Conversely, if r_{ij} is cost attribute, crisp minimal value ($\text{Min } x_{ij}$) of each column attribute divided by crisp values (x_{ij}) of each column.
5. Do the ranking process for each alternative (V_i) by multiplying the weight value (w_i) with a value of normalized performance rating (r_{ij}).

2.5.3 AHP and SAW Method Comparison

Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW) is the method used to solve the problem of decision making. Both methods have

different concepts, although its purpose in tune. However, AHP and SAW method has advantages and disadvantages of each are described in Table 2.7. [16]

Table 2.7 Comparison of AHP and SAW Method [16]

Analytical Hierarchy Process (AHP)	Simple Additive Weighting (SAW)
Advantage	
<ol style="list-style-type: none"> 1. Hierarchical structure by grouping selected criteria by sub-sub-criteria deepest. 2. Calculate the logical consistency in the assessment prioritization and lead to an approximation of how it wanted each alternative. 3. Consider the factors of relative priority in the system, so that decision makers can choose the best alternative according to their destination. 	<ol style="list-style-type: none"> 1. Selecting the best alternative from a number of alternatives that exist after determining the weight value for each attribute. 2. Being able to perform a more precise assessment because it is based on the criteria value and preference weighting that have been specified. 3. Can undertake simple assessment criteria to assess the status of the alternative, to normalize the results of the assessment criteria, and multiplying by weight priorities determined directly by decision makers.
Disadvantage	
<ol style="list-style-type: none"> 1. Only a mathematical method without any statistical test, so there is no limit of the confidence of the true model is formed. 2. Depending on the primary input is the perception of an expert, thus producing a subjective assessment. 	<ol style="list-style-type: none"> 1. The absence of statistical testing, so that this mathematical method does not have the confidence limits of the truth of the model is formed. 2. Requires the decision matrix normalization process to a scale which can be compared with an overall rating of existing alternatives.

2.6 Statistical Product and Service Solutions (SPSS)

SPSS Statistics is a comprehensive system for analyzing data. SPSS Statistics can take data from almost any type of file. The data is used to generate tabulated reports, charts and plots of distribution and trends, descriptive statistics, along complex statistical analysis. SPSS Statistics ownership is held by International Business Machines (IBM) Corporation. There are several types of window that is commonly used in all versions of SPSS Statistics, including [17]:

1. **Data Editor.** Data Editor displays the contents of the data file. Users can create new data files or modify existing data files in the Data Editor.
2. **Viewer.** All statistical results, tables, and charts are displayed in the Viewer. Users can edit the output and save it for later use. Viewer window opens automatically the first time users run a procedure that generates output.
3. **Pivot Table Editor.** Output that is displayed in pivot tables can be modified in various ways using the Pivot Table Editor. Users can edit text, swap data in rows and columns, add color, create multidimensional tables, and selectively hide and show results.
4. **Chart Editor.** Users can modify high-resolution charts and plots in the chart window. Users can change the colors, select type fonts or sizes are different, switch the horizontal and vertical axes, rotate 3-D scatterplots, and change the chart type.
5. **Text Output Editor.** Text output that is not displayed in pivot tables can be modified with the Text Output Editor. Users can edit the output and change font characteristics (type, style, color, size).
6. **Syntax Editor.** Users can paste the dialog box choices into syntax window, where the user's selections appears in the form of command syntax. Users can then edit the command syntax to use special features that are not available through dialog boxes. In addition, users can also save commands in a file to be used at the next session.

In this research, SPSS which will be used SPSS version 20 for test validity and reliability of the questionnaire results that has been given by the respondent. This version provides faster rendering of pivot tables. Pivot tables in version 20 is much faster than previous versions, but still maintaining full support for pivoting and editing. If the user uses a fast rendering of lightweight tables in version 19, users will find comparable results for pivot tables in version 20. Users who require compatibility with previous prior to 20 can choose to generate legacy tables (referred to as full-featured tables in version 19). [17]

2.7 Modus

Abbreviated modus with *mod* is a set that has the highest frequency or a value that most frequently appear. Modus is one of the measures of central tendency in the statistics science. Measures of central tendency is a measure that can represent the data as a whole. Modus has several levels. Distribution has one modus called unimodal. Distribution that has two modus called bimodal. Meanwhile, the distribution of which has more than 2 modus is called multimodal. In the distribution, the data also cannot have a modus. [18]

Modus value searching may be obtained from a single data and data group. For a single data, modus is obtained from the data that has the highest frequency. As for the data group, the modus is obtained from the equation 2.13. [18]

$$mod = L_0 + c \left\{ \frac{(f_1)_0}{(f_1)_0 + (f_2)_0} \right\} \quad (2.13)$$

$$(f_1)_0 = f_{m0} - f_{(m0-1)} \quad (2.14)$$

$$(f_2)_0 = f_{m0} - f_{(m0-2)} \quad (2.15)$$

Where:

mod : Value that appears most

L₀ : Lower limit value of existing classes modus

c : Large existing classes modus

f_{mi} : Frequency of existing classes modus

$(f_1)_0 = f_{m0} - f_{(m0-1)}$: The difference in the frequency of existing classes modus with the previous classes (bottom)

$(f_2)_0 = f_{m0} - f_{(m0-2)}$: The difference in the frequency of existing classes modus with the next classes (top)

2.8 Related Researches

One step in the process of studying the literature is that related researches.

Usually, related researches serve as a reference of the research to be conducted.

Previous research which is the reference journal of the Standards ISO 9126 with respective advantages and disadvantages are there described in Table 2.8.

Table 2.8 Regarding the Set Journal Standardization ISO 9126

No.	Journals	Author	Advantage	Disadvantage
1	“Analisis Pengujian Sistem Informasi Akademik Pranata Indonesia Berdasarkan Standard ISO 9126”	Imam Zaenuddin	1. The aim of this research was achieved, i.e. get an idea of the value of the system and measure the success rate of system utilization.	1. Weighting and ranking each factor not done, so it is not known what factors are a major priority.

No.	Journals	Author	Advantage	Disadvantage
			2. Determination of the factor value ISO 9126 carried out by a detailed and clear, like a Likert scale, Guttman scale, YSlow, Page Speed, questionnaires, etc.	
2	“Analisa Pengembangan Model Kualitas Berstruktur Hirarki dengan Kustomisasi ISO 9126 untuk Evaluasi Aplikasi Perangkat Lunak B2B”	Anita Hidayati, Sarwosri, Ariadi Retno Tri Hayati Ririd	<p>1. The aim of this research was achieved, i.e. the addition customize the characteristics of the ISO 9126 model in accordance with the characteristics of B2B applications.</p> <p>2. Conducting the process of weighting factors and sub-factors value and ranking with Fuzzy AHP and CASE Tool application, the main priority is the lowest priority factors are functionality and maintainability factors.</p>	<p>1. The number of respondent's only five respondents, making it less credibility because it does not meet the minimum requirements of the respondents suggested by experts.</p>
3	“Evaluasi Penerapan ERP pada Sistem Informasi Penjualan Properti berdasarkan ISO 9126”	Dwi Nurizal Priandani et al	<p>1. The aim of this research was achieved, i.e. to analyze and test how well the quality of the ERP implementation in property sales system.</p> <p>2. Very clear explanation of each factor using the White Box and Black Box in determining the quality of the ERP implementation in property sales information system.</p>	<p>1. The absence of objective assessment to the questionnaire to the system users, particularly in the usability factor.</p> <p>2. The absence of weighting and ranking each factor, so it is not known what factors are a major priority.</p>
4	Measuring Software Product Quality: A Survey of ISO / IEC 9126	Ho-Won Jung, Seung-Gweon Kim, and Chang Chung-Shing	1. The aim of this research was achieved, i.e. to evaluate the characteristics and dimensions of the classification of internal-consistency	1. Weighting characteristics and subcharacteristics not done, so the major priority is not known.

No.	Journals	Author	Advantage	Disadvantage
			<p>reliability ISO / IEC 9126 empirically.</p> <p>2. Doing questionnaire with 75 respondents who use a software package the company's products and 10 graduates of management information systems for pretest testing.</p> <p>3. Subcharacteristics measure of each characteristic by Principal Component Analysis (PCA).</p>	
5	Code Quality Evaluation Methodology Using the ISO / IEC 9126 Standard	Yiannis Kanellopoulos et al	<p>1. The aim of this research was achieved, i.e. obtaining software quality trends and express perceptions of the quality system experts in quantitative and systematic.</p> <p>2. Using AHP method to determine the metrics relative weight and source code for each characteristic and subcharacteristics.</p>	<p>1. Determination of the relative weight carried subjective, thus ranking the weight becomes less credibility.</p>

3 RESEARCH METHOD

3.1 Object Research

In this research, the object that will be used as a matter for the research are instant messenger applications on Android based which has a high popularity in Indonesia. Those instant messenger applications consist of BlackBerry Messenger (BBM), WhatsApp, and LINE. This research will be conducted only on a smartphone-sized < 5 inch.

3.2 Data Source

This research is using both of primary and secondary data source. Primary data is the data source that directly obtained by data collector [19]. The primary data is acquired by distributing the questionnaire to the respondent and performing a direct observation of instant messenger applications quality. While the secondary data is the data source that obtained by studying, reading, and understanding through other media such as a literature, books, as well as an enterprise document [19]. The secondary data is acquired through a literature study by reading and studying books, journals, articles, and other researches which related to measuring a software quality assurance based on ISO 9126-1 Quality Model. There are three data source that supported this research attainment, they are:

1. Gunadarma University Alumnus, that using mobile based instant messenger applications with S.Kom and S.T degree for determining the weight of characteristic and subcharacteristic ISO 9126-1 Quality Model,
2. User, that using those three popular instant messenger applications (BlackBerry Messenger, WhatsApp, and LINE) on Android based smartphone with screen size that less than 5 inch (< 5) in Indonesia for application quality assessment from the characteristic of Usability, and
3. Author, for application quality assessment from the characteristic of Functionality, Reliability, Efficiency, Maintainability, and Portability.

3.3 Population and Sample

Population is a generalization area which consists of an object or subject that has a certain quality and characteristic determined by a researcher to be studied then derived the conclusion [19]. While sample is a part of population characteristic that possessed [19]. There are two population used in this research. First is a population of mobile based instant messenger application user which has S.Kom and S.T degree. Second is a population of smartphone user in Indonesia that using BlackBerry Messenger (BBM), WhatsApp, and LINE application.

Measurement on the first population is unknown therefore the sample measurement determine based on Roscoe. According to Roscoe in Research Methods for Business book, a proper sample measurement used in a research is between 30 – 50 respondent [19]. Therefore, the distribution of a questionnaire that needed for a sample measurement to determine the weight of characteristic and

subcharacteristic are 30 of respondent. While the sampling technique used in this questionnaire is Simple Random Sampling that performed randomly without looking at the existing population stratum [19].

The second population measurement is different with the first population measurement, because the second population could be found from the information of total smartphone user in Indonesia that spread by Horace H. Dedi through his personal blog, asymco.com. Horace stated that Indonesia is occupying the fifth rank with 47 million active smartphone users [20]. From 470 million users, 79% or 371 million users using BlackBerry Messenger (BBM), 57% or 268 million users using WhatsApp, and 30% or 141 million user using LINE [2]. When the population measurement is known, then the sample measurement also could be determined. This sample measurement used to find out a total of respondent that needed for questionnaire distribution. The information of the popular instant messenger application used in Indonesia could be seen in Figure 3.1.

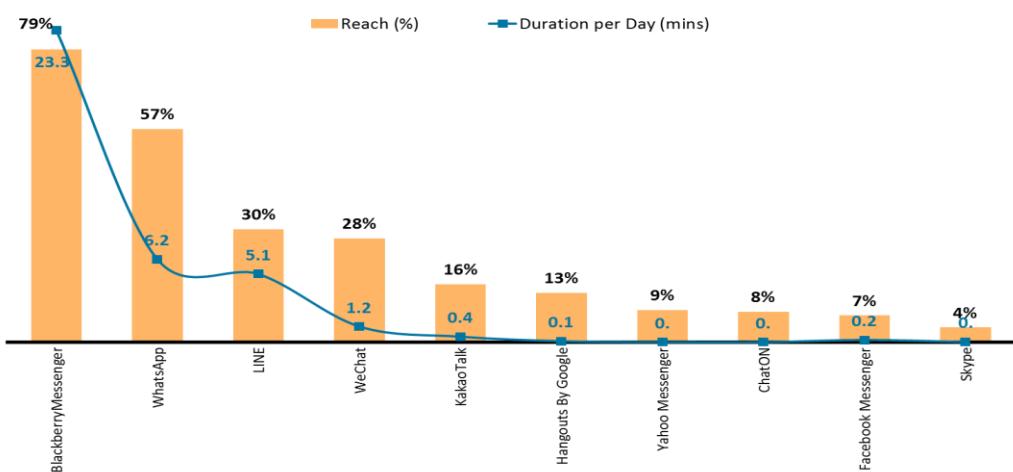


Figure 3.1 User Graph of Instant Messenger Application in Indonesia [2]

Total user that using those popular instant messenger applications have to be determined, so a calculation in a set of Venn diagrams performed. But before the Venn diagrams calculation performed, the total smartphone user opportunity that using BlackBerry Messenger (BBM), WhatsApp, and LINE application has to be found. The calculation performed with assuming those instant messenger applications paired and referred to Figure 3.1.

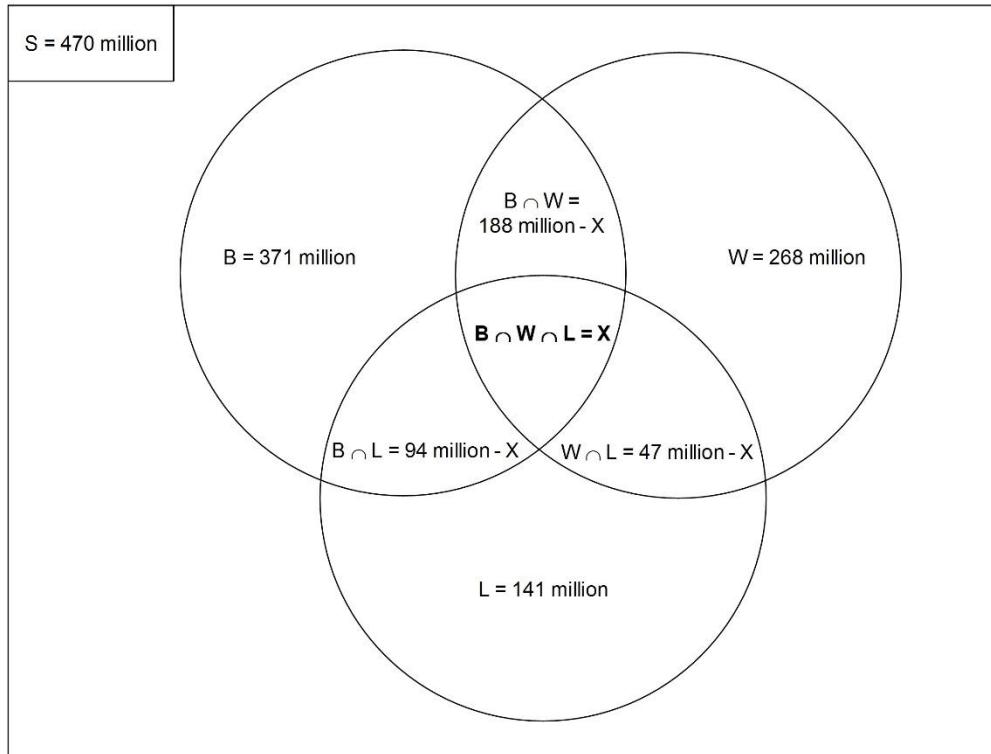
Assumption:

$$\text{BBM \& WhatsApp} : 40\% \times 470 \text{ million} = 188 \text{ million user}$$

$$\text{BBM \& LINE} : 20\% \times 470 \text{ million} = 94 \text{ million user}$$

$$\text{WhatsApp \& LINE} : 10\% \times 470 \text{ million} = 47 \text{ million user}$$

Percentage parable performed could not be exceeding the least percentage of compared instant messenger application. For example, the least percentage between BBM and WhatsApp that possessed by WhatsApp is 57%, so Author has to deciding the percentage that less than 57% and assuming the 40% percentage. The compared percentage for BBM & LINE as well as WhatsApp & LINE also determined by doing a same process as BBM & WhatsApp percentage. After the total smartphone user opportunity that using BlackBerry Messenger (BBM), WhatsApp, and LINE found, Venn diagrams calculation could be performed and presented in Figure 3.2.

**NOTES:**

- S = Universal set (the entire smartphone users in Indonesia)
- X = Component set of S that is a combination set of B, W, and L
- B = Component set of S who use BlackBerry Messenger on smartphones
- W = Component set of S who use WhatsApp on smartphones
- L = Component set of S who use LINE on smartphones

Figure 3.2 Venn Diagrams for BBM, WhatsApp, and LINE Application User

The equation for finding X value is described in Figure 3.2 as follows:

$$S = B + \left(W - ((B \cap W) + X + (W \cap L)) \right) + \left(L - ((B \cap L) + X + (W \cap L)) \right) \quad (3.1)$$

From the equation 3.1, X value that is a component set of S and composite set of B, W, and L could be completed from the calculation as follows:

$$\begin{aligned} 470 &= 371 + (268 - ((188 - X) + X + (47 - X))) + (141 - ((94 - X) + X \\ &\quad + (47 - X))) \end{aligned}$$

$$470 = 371 + (268 - (235 - X)) + (141 - (141 - X))$$

$$470 = 371 + (268 - 235 + X) + (141 - 141 + X)$$

$$470 = 371 + 33 + X + X$$

$$470 - 371 - 33 = 2X$$

$$66 = 2X$$

$$X = 33 \text{ (million user)}$$

With the X value that equal to 33 million user ($X = 33$ million user), the total sample could be determined as a total of respondent which needed for distributing the questionnaire to find out a quality of those three popular instant messenger from Usability characteristic. The questionnaire is using Simple Random Sampling technique, which is part of Probability Sampling. According to Sugiyono, Probability Sampling is a sampling technique that gives an equal opportunity for each population component to be selected as a sample component [19]. The Simple Random Sampling technique is selected due to this technique simple and could be performed randomly without looking at the existing population stratum [19]. Determining of total sample for this questionnaire is using Solvin formula sample measurement with the equation that presented as follows:

$$n = \frac{N}{1+(N+\alpha^2)} \quad (3.2)$$

Where:

n : Sample size

N : Population size

α : Error rate ($\alpha = 0.07$)

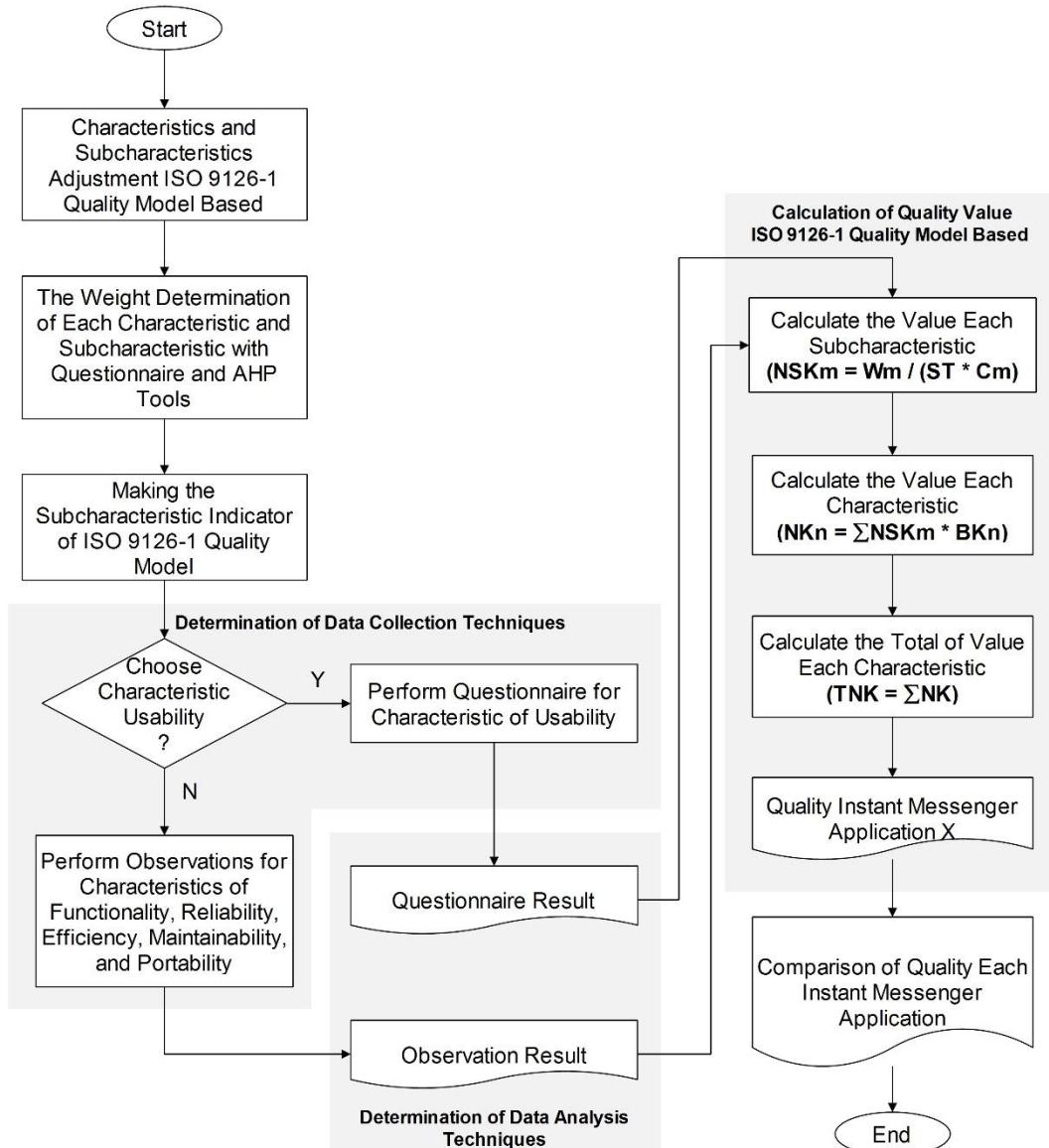
Therefore, population measurement for those three popular instant messenger applications user (N) are 33,000,000 and the error rate (α) is 0.07 or 7%, then the sample measurement value (n) is as follows:

$$n = \frac{N}{1 + (N \times \alpha^2)} = \frac{33,000,000}{1 + (33,000,000 \times (0.07)^2)} = 204.0803706 \approx 204$$

In Solvin formula, the α value could be assumed by the researcher according to the existing consideration. The number of total sample that obtained from the Solvin formula calculation is 204 respondents with 93% confidence level.

3.4 Research Methodology

There are some phases that must be conducted to find out the quality of these popular instant messenger applications (BlackBerry Messenger, WhatsApp, and LINE). The phases are drawn as a flowchart form that presented in Figure 3.3.

**NOTES:**

m : Subcharacteristic for m
 n : Characteristic for n
 X : Instant Messenger Application for X
 NSK : Subcharacteristic Value
 W : Weight of Subcharacteristic
 ST : Top Scores on Likert Scale ($ST = 5$)

C : Value obtained from questionnaire results or Observation on each subcharacteristic
 NK : Characteristic Value
 BK : Weight of Characteristic
 TNK : Total Value of Characteristic

Figure 3.3 Flowchart Phases to Test Instant Messenger Application Quality

Figure 3.3 is displaying the phase to find out each quality of three popular instant messenger are begin with determining the characteristic and subcharacteristic based on ISO 9126-1 Quality Model until the comparing process.

3.4.1 Adjustment of Characteristics and Subcharacteristic ISO 9126-1

Software quality model that selected with ISO 9126-1 Quality Model performed accord with instant messenger application needed. ISO 9126-1 Quality Model 2001 version has 6 characteristics and 27 subcharacteristics [14]. However, this research will be used 6 characteristics and 24 subcharacteristics that presented in Table 3.1.

Table 3.1 ISO 9126-1 Quality Model that has been adjusted

Characteristics	Subcharacteristics
Functionality	Suitability Accuracy Interoperability Security Compliance Functionality
Reliability	Maturity Fault Tolerance Recoverability Reliability Compliance
Usability	Understandability Learnability Operability Attractiveness Usability Compliance
Efficiency	Time Behaviour Resource Utilization Efficiency Compliance
Maintainability	Analyzability Maintainability Compliance
Portability	Adaptability Installability Coexistence Replaceability Portability Compliance

Detail description for each characteristic and subcharacteristic existing in Table 3.1 is as follows:

1. Functionality

Functionality is software capability to provide an appropriate function when user needs it in a certain condition. There are five subcharacteristics that possessed by Functionality characteristic which will be used to measuring the quality of those three popular instant messenger applications. Detail explanation about the subcharacteristic is presented in Table 3.2.

Table 3.2 Functionality Subcharacteristic

Subcharacteristics	Description
Suitability	Software capability that related to feasibility or compatibility for certain tasks.
Accuracy	Software capability to gives precise result.
Interoperability	Software capability to interacting with other system.
Security	Software capability to protect user importance secrecy and avoid not desirable access.
Compliance Functionality	Software capability in comply with standard and requirement according to the regulation that related to functionality.

2. Reliability

Reliability is software capability in performance level maintaining when it used in a certain condition. There are four subcharacteristics that possessed by Reliability characteristic which will be used to measuring the quality of those three popular instant messenger applications. Detail explanation about the subcharacteristic is presented in Table 3.3.

Table 3.3 Reliability Subcharacteristic

Subcharacteristics	Description
Maturity	Software capability that related to fault and failure frequencies in the application.
Fault Tolerance	Software capability to maintaining the performance level when the software failure or interface infraction determined is happen.
Recoverability	Software capability to recover the performance level and the data when a system, data, or network connection failure is happen.
Reliability Compliance	Software capability in comply with standard and requirement according to the regulation that related to reliability.

3. Usability

Usability is software capability that related to the use of software which is done by the user. There are five subcharacteristics that possessed by Usability characteristic which will be used to measuring the quality of those three popular instant messenger applications. Detail explanation about the subcharacteristic is presented in Table 3.4.

Table 3.4 Usability Subcharacteristic

Subcharacteristics	Description
Understandability	Software capability to provide an easiness to be understood by user.
Learnability	Software capability to provide an easiness to be learned by user.
Operability	Software capability to provide an easiness to be operated by user.
Attractiveness	Software capability in drawing user attention.
Usability Compliance	Software capability in comply with standard and requirement according to the regulation that related to usability.

4. Efficiency

Efficiency is software capability in providing an appropriate performance level and total resource used when the software is running. There are three

subcharacteristics that possessed by Efficiency characteristic which will be used to measuring the quality of those three popular instant messenger applications. Detail explanation about the subcharacteristic is presented in Table 3.5.

Table 3.5 Efficiency Subcharacteristic

Subcharacteristics	Description
Time Behaviour	Software capability to provide a respond and appropriate processing time when carrying out its functions.
Resource Utilization	Software capability to use its possessed resources when carrying out determined functions.
Efficiency Compliance	Software capability in comply with standard and requirement according to the regulation that related to efficiency.

5. Maintainability

Maintainability is software capability that related to the efforts needed to be modified or changed. There are five subcharacteristics that possessed by Maintainability characteristic, however only two subcharacteristic in this research which will be used to measuring the quality of those three popular instant messenger applications. Detail explanation about the subcharacteristic is presented in Table 3.6.

Table 3.6 Maintainability Subcharacteristic

Subcharacteristics	Description
Analyzability	Software capability to diagnosis a lacking or cause of a failure as well as identify a part that will be modified.
Maintainability Compliance	Software capability in comply with standard and requirement according to the regulation that related to maintainability.

The other three subcharacteristics that unused in Maintainability characteristic are Changeability, Stability, and Testability. This matter is

due to these three characteristic are only could be used by the developer from each instant messenger applications. These subcharacteristics also has an effect to each other, there are modifies process (Changeability), modified after effect (Stability), and the validation of software that has been modified (Testability).

6. Portability

Portability is software capability which enables the software to be sent to other environment. There are five subcharacteristics that possessed by Portability characteristic which will be used to measuring the quality of those three popular instant messenger applications. Detail explanation about the subcharacteristic is presented in Table 3.7.

Table 3.7 Portability Subcharacteristic

Subcharacteristics	Description
Adaptability	Software capability which enable the system to adapt in a different environment.
Installability	Software capability which enables the system to easily installed in a different environment.
Coexistence	Software capability which enable the system border on with another system in an environment by resource sharing.
Replaceability	Software capability that used as a substitute to other similar software.
Portability Compliance	Software capability in comply with standard and requirement according to the regulation that related to portability.

3.4.2 Weighting of Characteristic and Subcharacteristic ISO 9126-1

Characteristic and subcharacteristic ISO 9126-1 Quality Model weighting is determined by using Analytic Hierarchy Process (AHP) method with BPMSG AHP Priority Calculator tools. This tools is used to provide a decision of weight calculation that obtain the highest up to the lowest priority. This tools which made by Klaus D. Goepel could be accessed through this website: http://bpmsg.com/academic/ahp_calc.php.

The weighting process will be distributed through the questionnaire for 30 respondents, as already mention in Population and Sample section. There are some phases that conducted to characteristic and subcharacteristic weighting with BPMSG AHP Priority Calculator tools as follows:

1. Input the number of characteristic or subcharacteristic that will be compared, as could be seen in Figure 3.4.

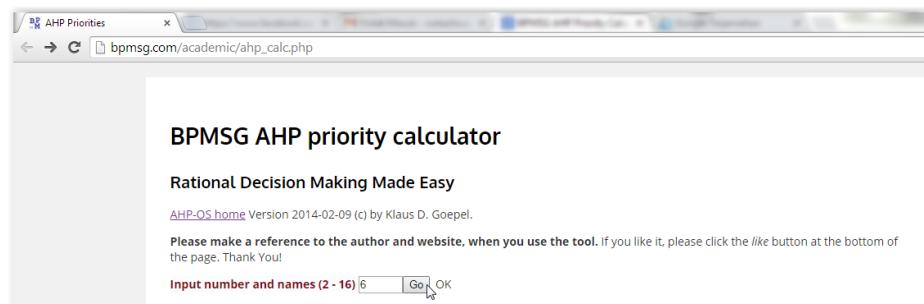


Figure 3.4 Characteristic and Subcharacteristic Input Number

2. Fill out the characteristic or subcharacteristic name that will be compared, as could be seen in Figure 3.5.

AHP Priorities

Please fill out project title and name of criteria

Aplikasi Instant Messenger	
Name of criteria	
1	Functionality
2	Reliability
3	Usability
4	Efficiency
5	Maintainability
6	Portability
max. 35 character ea.	
<input style="border: 1px solid black; padding: 2px 10px; cursor: pointer;" type="button" value="OK"/>	

Figure 3.5 Characteristic and Subcharacteristic Input Name

3. Compare each characteristic or subcharacteristic with AHP intensity of pairwise comparison (see Table 3.28) according to respondent average questionnaire filling. Then, press Calculate Result button as could be seen in Figure 3.6.

A - Importance - or B?		Equal	How much more?
1	<input checked="" type="radio"/> Functionality or <input type="radio"/> Reliability	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input checked="" type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input checked="" type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
2	<input checked="" type="radio"/> Functionality or <input type="radio"/> Usability	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input checked="" type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
3	<input checked="" type="radio"/> Functionality or <input type="radio"/> Efficiency	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input checked="" type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
4	<input checked="" type="radio"/> Functionality or <input type="radio"/> Maintainability	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input checked="" type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
5	<input checked="" type="radio"/> Functionality or <input type="radio"/> Portability	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input checked="" type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
6	<input type="radio"/> Reliability or <input type="radio"/> Usability	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input checked="" type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
7	<input type="radio"/> Reliability or <input type="radio"/> Efficiency	<input checked="" type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
8	<input type="radio"/> Reliability or <input type="radio"/> Maintainability	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input checked="" type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
9	<input type="radio"/> Reliability or <input type="radio"/> Portability	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input checked="" type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
10	<input type="radio"/> Usability or <input type="radio"/> Efficiency	<input checked="" type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
11	<input type="radio"/> Usability or <input type="radio"/> Maintainability	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input checked="" type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
12	<input type="radio"/> Usability or <input type="radio"/> Portability	<input checked="" type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
13	<input type="radio"/> Efficiency or <input type="radio"/> Maintainability	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input checked="" type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
14	<input type="radio"/> Efficiency or <input type="radio"/> Portability	<input checked="" type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
15	<input type="radio"/> Maintainability or <input type="radio"/> Portability	<input checked="" type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10	<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10
CR = 9.1% OK			
<input style="border: 1px solid black; padding: 2px 10px; cursor: pointer;" type="button" value="Calculate Result"/>		<input checked="" type="radio"/> AHP <input type="radio"/> Balanced scale	<input style="border: 1px solid black; padding: 2px 10px; cursor: pointer;" type="button" value="Download (.csv)"/>
<input type="checkbox"/> dec. comma			

Figure 3.6 Characteristic or Subcharacteristic Pairwise Comparison

4. If Consistency Ratio value $\leq 10\%$, then characteristic or subcharacteristic as well as decision matrix ranking that reputed as a consistence value appear, and could be serving as a reference for the weighting determination that could be seen in Figure 3.7.

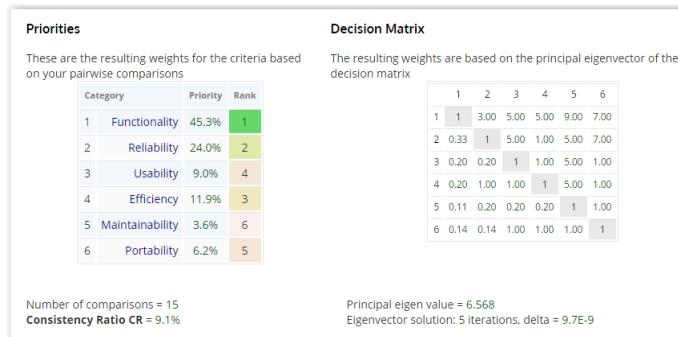


Figure 3.7 Characteristic/Subcharacteristic Matrix and Rank

5. If Consistency Ratio value $> 10\%$, then each characteristic or subcharacteristic comparison has to be repeated to the third phase. Besides, this tools also provides a recommendation to change a comparison that already conducted by the user in order to obtain a qualify Consistency Ratio (CR) value, as could be seen in Figure 3.8.



Figure 3.8 Unqualified Pairwise Comparison CR Value

Respondent that filling out the weighting questionnaire has a requirement. The requirement is the respondent who had experience in using mobile based instant messenger applications and has a technology background with bachelor of computer science (S.Kom) and engineering (S.T) degree. When the requirements could be fulfilled by respondent, this ranking of weight could be obtained an objective and reliable priority order in each characteristic or subcharacteristic.

3.4.3 Indicators Generated of Subcharacteristic ISO 9126-1

The indicator is generated for 24 subcharacteristics that already adjusted with common instant messenger application. This indicator generated in order to the questionnaire as well as the observation that conducted could be measured accordance with the limits that has been set. This matter obtains a quantitative valuation. The valuation range in observing and analyzing three popular instant messenger applications are in between 1 – 5 value and it is according to the indicator definition in each subcharacteristic.

Indicator on each subcharacteristic of Functionality that could be reference to measuring the quality of three popular instant messenger applications is as follows:

1. Suitability

The valuation of Suitability subcharacteristic is seen from the conformity function that running when the user accessing the BlackBerry Messenger (BBM), WhatsApp, or LINE application. Suitability subcharacteristic indicator is presented in Table 3.8.

Table 3.8 Valuation of Suitability Subcharacteristic Indicator

Range	Indicator	Definition
1	There are 0% - 30% functions that running when user accessing the application.	Very Bad
2	There are 31% - 50% functions that running when user accessing the application.	Bad
3	There are 51% - 70% functions that running when user accessing the application.	Sufficient
4	There are 71% - 90% functions that running when user accessing the application.	Good
5	There are 91% - 100% functions that running when user accessing the application.	Very Good

2. Accuracy

The valuation of Accuracy subcharacteristic is seen from the accurately or inaccurately output that given by BlackBerry Messenger (BBM), WhatsApp, or LINE application when users run the existing functions. Accuracy subcharacteristic indicator is presented in Table 3.9.

Table 3.9 Valuation of Accuracy Subcharacteristic Indicator

Range	Indicator	Definition
1	0% - 20% the output result is accurate when users run the existing application functions.	Very Bad
2	21% - 40% the output result is accurate when users run the existing application functions.	Bad
3	41% - 60% the output result is accurate when users run the existing application functions.	Sufficient
4	61% - 80% the output result is accurate when users run the existing application functions.	Good
5	81% - 100 the output result is accurate when users run the existing application functions.	Very Good

3. Interoperability

The valuation of Interoperability subcharacteristic is seen from the ability or inability BlackBerry Messenger (BBM), WhatsApp, or LINE

application in interaction with other system that beyond the application.

Interoperability subcharacteristic indicator is presented in Table 3.10.

Table 3.10 Valuation of Interoperability Subcharacteristic Indicator

Range	Indicator	Definition
1	No interaction can be done with any system that beyond the application.	Very Bad
2	There is an interaction that can be done with 1 system that beyond the application.	Bad
3	There is an interaction that can be done with 2 – 3 systems that beyond the application.	Sufficient
4	There is an interaction that can be done in 4 – 5 systems that beyond the application.	Good
5	There is an interaction that can be done with more than 5 systems that beyond the application.	Very Good

4. Security

The valuation of Security subcharacteristic is seen from the ability or inability BlackBerry Messenger (BBM), WhatsApp, or LINE application in maintain the confidentiality of messages users and prevent unauthorized access. Security subcharacteristic indicator is presented in Table 3.11.

Table 3.11 Valuation of Security Subcharacteristic Indicator

Range	Indicator	Definition
1	There is no message encryption process and has 0% - 30% security systems.	Very Bad
2	There is no message encryption process and has 31% - 50% security systems.	Bad
3	Has a message encryption process and 51% - 70% security systems.	Sufficient
4	Has a message encryption process and 71% - 90% security systems.	Good
5	Has a message encryption process and 91% - 100% security system.	Very Good

5. Functionality Compliance

The valuation of Functionality Compliance subcharacteristic is seen from the worthy or unworthy BlackBerry Messenger (BBM), WhatsApp, or LINE application in meet the standard instant messenger applications on the functionality aspect. Functionality Compliance subcharacteristic indicator is presented in Table 3.12.

Table 3.12 Functionality Compliance Subcharacteristic Indicator

Range	Indicator	Definition
1	There is no standard application that meets the functionality aspect.	Very Bad
2	There is 1 standard application that meets the functionality aspect.	Bad
3	There are 2 standard applications that meet the functionality aspect.	Sufficient
4	There are 3 - 4 standard applications that meet the functionality aspect.	Good
5	There are 5 standard applications that meet the functionality aspect.	Very Good

Indicator on each subcharacteristic of Reliability that could be reference to measuring the quality of three popular instant messenger applications is as follows:

1. Maturity

The valuation of Maturity subcharacteristic is seen from the ability or inability BlackBerry Messenger (BBM), WhatsApp, or LINE application in frequency to avoid malfunction due to an application error. Maturity subcharacteristic indicator is presented in Table 3.13.

Table 3.13 Valuation of Maturity Subcharacteristic Indicator

Range	Indicator	Definition
1	The application can avoid malfunction messaging frequency between 0% - 20%.	Very Bad
2	The application can avoid malfunction messaging frequency between 21% - 40%.	Bad
3	The application can avoid malfunction messaging frequency between 41% - 60%.	Sufficient
4	The application can avoid malfunction messaging frequency between 61% - 80%.	Good
5	The application can avoid malfunction messaging frequency between 81% - 100%.	Very Good

2. Fault Tolerance

The valuation of Fault Tolerance subcharacteristic is seen from the ability or inability BlackBerry Messenger (BBM), WhatsApp, or LINE application in maintaining the performance of the application when an error occurs on the system or when users make mistakes. Fault Tolerance subcharacteristic indicator is presented in Table 3.14.

Table 3.14 Valuation of Fault Tolerance Subcharacteristic Indicator

Range	Indicator	Definition
1	The application can provide fault tolerance between 0% - 20% chance.	Very Bad
2	The application can provide fault tolerance between 21% - 40% chance.	Bad
3	The application can provide fault tolerance between 41% - 60% chance.	Sufficient
4	The application can provide fault tolerance between 61% - 80% chance.	Good
5	The application can provide fault tolerance between 81% - 100% chance.	Very Good

3. Recoverability

The valuation of Recoverability subcharacteristic is seen from the ability or inability BlackBerry Messenger (BBM), WhatsApp, or LINE

application in continuing its work back and restore user data if there is an error in the system and network connections. Recoverability subcharacteristic indicator is presented in Table 3.15.

Table 3.15 Valuation of Recoverability Subcharacteristic Indicator

Range	Indicator	Definition
1	No task can be resumed and the data restored when an error occurs on a system or network connection.	Very Bad
2	Tasks can be resumed and the data can be recovered when there is 1 error in the system or network connection.	Bad
3	Tasks can be resumed and the data can be recovered in when there are 2 errors in the system or network connection.	Sufficient
4	Tasks can be resumed and the data can be recovered in when there are 3 - 4 errors in the system or network connection.	Good
5	Tasks can be resumed and the data can be recovered in when there are 5 errors in the system or network connection.	Very Good

4. Reliability Compliance

The valuation of Reliability Compliance subcharacteristic is seen from the worthy or unworthy BlackBerry Messenger (BBM), WhatsApp, or LINE application in meet the standard instant messenger applications on the reliability aspect. Reliability Compliance subcharacteristic indicator is presented in Table 3.16.

Table 3.16 Reliability Compliance Subcharacteristic Indicator

Range	Indicator	Definition
1	There is no standard application that meets the reliability aspect.	Very Bad
2	There is 1 standard application that meets the reliability aspects.	Bad
3	There are 2 standard applications that meet the reliability aspect.	Sufficient
4	There are 3 standard applications that meet the reliability aspect.	Good

Range	Indicator	Definition
5	There are more than 3 standard applications that meet the reliability aspect.	Very Good

Specifically for the Usability characteristics, each subcharacteristic of Usability has the same indicators as a reference in measuring the quality three popular instant messenger applications. It causes the value of each subcharacteristic obtained from the Usability questionnaire results that includes Understandability, Learnability, Portability, Attractiveness, and Usability Compliance subcharacteristic. Results of the questionnaire feasibility percentage is converted into a Likert scale, so the valuation indicators can be compiled. Indicators of each subcharacteristic on Usability is presented in Table 3.17.

Table 3.17 Valuation Indicators of Each Subcharacteristic on Usability

Range	Indicator	Definition
1	Feasibility percentage obtained at each subcharacteristic of < 5%.	Very Bad
2	Feasibility percentage obtained at each subcharacteristic between 5% - 24.99%.	Bad
3	Feasibility percentage obtained at each subcharacteristic between 25% - 44.99%.	Sufficient
4	Feasibility percentage obtained at each subcharacteristic between 45% - 64.99%.	Good
5	Feasibility percentage obtained at each subcharacteristic of $\geq 65\%$.	Very Good

Indicator on each subcharacteristic of Efficiency that could be reference to measuring the quality of three popular instant messenger applications is as follows:

1. Time Behaviour

The valuation of Time Behaviour subcharacteristic is seen from the the fast or absence BlackBerry Messenger (BBM), WhatsApp, or LINE

application in response and processing times appropriate when carrying out its functions. Time Behaviour subcharacteristic indicator is presented in Table 3.18.

Table 3.18 Valuation of Time Behaviour Subcharacteristic Indicator

Range	Indicator	Definition
1	Maximum response and processing time in performing functions: a. Short messages of <80 characters is 3 milliseconds. b. Normal message as much as 80 - 160 characters is 3.5 milliseconds. c. Long messages of >160 characters is 4 milliseconds.	Very Bad
2	Maximum response and processing time in performing functions: a. Short messages of <80 characters is 2.5 milliseconds. b. Normal message as much as 80 - 160 characters is 3 milliseconds. c. Long messages of >160 characters is 3.5 milliseconds.	Bad
3	Maximum response and processing time in performing functions: a. Short messages of <80 characters is 2 milliseconds. b. Normal message as much as 81 - 160 characters is 2.5 milliseconds. c. Long messages of >160 characters is 3 milliseconds.	Sufficient
4	Maximum response and processing time in performing functions: a. Short messages of <80 characters is 1.5 milliseconds. b. Normal message as much as 81 - 160 characters is 2 milliseconds. c. Long messages of >160 characters is 2.5 milliseconds.	Good
5	Maximum response and processing time in performing functions: a. Short messages of <80 characters is 1 millisecond. b. Normal message as much as 81 - 160 characters is 1.5 milliseconds. c. Long messages of >160 characters is 2 milliseconds.	Very Good

2. Resource Utilization

The valuation of Resource Utilization subcharacteristic is seen from the ability or inability BlackBerry Messenger (BBM), WhatsApp, or LINE application in using its resources when running specified functions. The resources are RAM (Random Access Memory) and memory applications. Resource Utilization subcharacteristic indicator is presented in Table 3.19.

Table 3.19 Valuation of Resource Utilization Subcharacteristic Indicator

Range	Indicator	Definition
1	Resource utilization when executing functions specified spending: a. RAM storage for > 70 MB. b. Memory of 76 - 85 MB.	Very Bad
2	Resource utilization when executing functions specified spending: a. RAM storage of 61 - 70 MB. b. Memory of 66 - 75 MB.	Bad
3	Resource utilization when executing functions specified spending: a. RAM storage of 51 - 60 MB. b. Memory of 56 - 65 MB.	Sufficient
4	Resource utilization when executing functions specified spending: a. RAM storage of 41 - 50 MB. b. Memory of 46 - 55 MB.	Good
5	Resource utilization when executing functions specified spending: a. RAM storage of \leq 40 MB. b. Memory of \leq 45 MB.	Very Good

3. Efficiency Compliance

The valuation of Efficiency Compliance subcharacteristic is seen from the worthy or unworthy BlackBerry Messenger (BBM), WhatsApp, or LINE application in meet the standard instant messenger applications on the

efficiency aspect. Efficiency Compliance subcharacteristic indicator is presented in Table 3.20.

Table 3.20 Efficiency Compliance Subcharacteristic Indicator

Range	Indicator	Definition
1	There is no standard application that meets the efficiency aspect.	Very Bad
2	There is 1 application that meets the standard efficiency aspects.	Bad
3	There are 2 - 3 standard applications that meet the efficiency aspect.	Sufficient
4	There are 4 - 5 standard applications that meet the efficiency aspect.	Good
5	There are 6 standard applications that meet the efficiency aspect.	Very Good

Indicator on each subcharacteristic of Maintainability that could be reference to measuring the quality of three popular instant messenger applications is as follows:

1. Analyzability

The valuation of Analyzability subcharacteristic is seen from the ability or inability BlackBerry Messenger (BBM), WhatsApp, or LINE application in diagnosing deficiencies or causes of failures in application.

Analyzability subcharacteristic indicator is presented in Table 3.21.

Table 3.21 Valuation of Analyzability Subcharacteristic Indicator

Range	Indicator	Definition
1	0% - 20% can diagnose deficiencies or causes of failures when running a function.	Very Bad
2	21% - 40% can diagnose deficiencies or causes of failures when running a function.	Bad
3	41% - 60% can diagnose deficiencies or causes of failures when running a function.	Sufficient
4	61% - 80% can diagnose deficiencies or causes of failures when running a function.	Good

Range	Indicator	Definition
5	81% - 100% can diagnose deficiencies or causes of failures when running a function.	Very Good

2. Maintainability Compliance

The valuation of Maintainability Compliance subcharacteristic is seen from the worthy or unworthy BlackBerry Messenger (BBM), WhatsApp, or LINE application in meet the standard instant messenger applications on the maintainability aspect. Maintainability Compliance subcharacteristic indicator is presented in Table 3.22.

Table 3.22 Maintainability Compliance Subcharacteristic Indicator

Range	Indicator	Definition
1	There is no standard application that meets the maintenance aspect.	Very Bad
2	There is 1 standard applications that meets the maintenance aspect.	Bad
3	There are 2 standard applications that meets the maintenance aspect.	Sufficient
4	There are 3 standard applications that meets the maintenance aspect.	Good
5	There are more than 3 standard applications that meets the maintenance aspect.	Very Good

Indicator on each subcharacteristic of Portability that could be reference to measuring the quality of three popular instant messenger applications is as follows:

1. Adaptability

The valuation of Adaptability subcharacteristic is seen from the ability or inability BlackBerry Messenger (BBM), WhatsApp, or LINE application in adapting to different environments. The environment is any version of

the Android operating system with various smartphone screen size <5 inch. Adaptability subcharacteristic indicator is presented in Table 3.23.

Table 3.23 Valuation of Adaptability Subcharacteristic Indicator

Range	Indicator	Definition
1	Unable to adapt to different environments.	Very Bad
2	Can adapt to the 1 version of the Android operating system on a smartphone screen size of < 5 inch.	Bad
3	Can adapt to the 2 version of the Android operating system on a smartphone screen size of < 5 inch.	Sufficient
4	Can adapt to the 3 – 4 version of the Android operating system on a smartphone screen size of < 5 inch.	Good
5	Can adapt to all versions of the Android operating system on a smartphone screen size of < 5 inch.	Very Good

2. Installability

The valuation of Installability subcharacteristic is seen from the ability or inability BlackBerry Messenger (BBM), WhatsApp, or LINE application when installing the application in different environments. The environment is any version of the Android operating system with various smartphone screen size <5 inch. Installability subcharacteristic indicator is presented in Table 3.24.

Table 3.24 Valuation of Installability Subcharacteristic Indicator

Range	Indicator	Definition
1	Unable to install the application for different environments.	Very Bad
2	Can install the application on a 1 version of the Android operating system smartphone with a screen size of <5 inch.	Bad
3	Can install the application on a 2 version of the Android operating system smartphone with a screen size of <5 inch.	Sufficient
4	Can install the application on a 3 – 4 version of the Android operating system smartphone with a screen size of <5 inch.	Good
5	Can install the application on all versions of the Android operating system with a smartphone screen size of <5 inch.	Very Good

3. Coexistence

The valuation of Coexistence subcharacteristic is seen from the ability or inability BlackBerry Messenger (BBM), WhatsApp, or LINE application when side by side with other application in the environment by sharing resources. Coexistence subcharacteristic indicator is presented in Table 3.25.

Table 3.25 Valuation of Coexistence Subcharacteristic Indicator

Range	Indicator	Definition
1	0% - 20% can co-exist with other application in the environment by sharing resources.	Very Bad
2	21% - 40% can co-exist with other application in the environment by sharing resources.	Bad
3	41% - 60% can co-exist with other application in the environment by sharing resources.	Sufficient
4	61% - 80% can co-exist with other application in the environment by sharing resources.	Good
5	81% - 100% can co-exist with other application in the environment by sharing resources.	Very Good

4. Replaceability

The valuation of Replaceability subcharacteristic is seen from the ability or inability BlackBerry Messenger (BBM), WhatsApp, or LINE application to be used as a substitute for similar application. Replaceability subcharacteristic indicator is presented in Table 3.26.

Table 3.26 Valuation of Replaceability Subcharacteristic Indicator

Range	Indicator	Definition
1	Cannot replace other similar application.	Very Bad
2	Can replace 1 other similar application.	Bad
3	Can replace 2 – 3 other similar application.	Sufficient
4	Can replace 4 – 5 other similar application.	Good
5	Can replace more than 5 other similar application.	Very Good

5. Portability Compliance

The valuation of Portability Compliance subcharacteristic is seen from the worthy or unworthy BlackBerry Messenger (BBM), WhatsApp, or LINE application in meet the standard instant messenger applications on the portability aspect. Portability Compliance subcharacteristic indicator is presented in Table 3.27.

Table 3.27 Portability Compliance Subcharacteristic Indicator

Range	Indicator	Definition
1	There is no standard application that meets the portability aspect.	Very Bad
2	There is 1 standard application that meets the portability aspect.	Bad
3	There are 2 standard applications that meet the portability aspect.	Sufficient
4	There are 3 - 4 standard applications that meet the portability aspect.	Good
5	There are 5 standard applications that meet the portability aspect.	Very Good

3.4.4 Determination of Data Collection Techniques

Data collection methods in this research was conducted through questionnaires and observations obtained from the research data. The questionnaire is a technique of data collection is done by providing a set of written questions to be answered by the respondents [19]. There are two questionnaires in this research, the questionnaire of ISO 9126-1 Quality Model weighting and valuation of Usability characteristics.

Questionnaire for characteristics and subcharacteristics weighting will be distributed to users who using instant messenger application mobile-based that

holds S.Kom and S.T degree. The questionnaire is based on the valuation scale of Analytical Hierarchy Process (AHP) is described in Table 3.28 [15].

Table 3.28 Intensity of AHP Pairwise Comparison [15]

Intensity	Definition	Explanation
1	Equal Importance	Both elements have the same effect is important.
3	Moderate Importance	Elements that one a little more important than other elements.
5	Strong Importance	Elements which one is more important than other elements.
7	Very Strong Importance	Elements of the much more important than other elements.
9	Extreme Importance	One element is absolutely more important than other elements.
2, 4, 6, 8	Representing the values of the intermediate between the two elements.	
Reverse	If activity i got one point compared with activity j , then j has the opposite value compared with i .	

Meanwhile, the questionnaire for the valuation of the Usability characteristics will be distributed to the user who using three popular instant messenger applications in Indonesia. This questionnaire will be using J.R. Lewis questionnaires with Likert scale measurement of the alternative answers presented in Table 3.29.

Table 3.29 Likert Scale Interpretation

Scale	Interpretation	
1	STS	: Very Disagree
2	TS	: Disagree
3	N	: Neutral
4	S	: Agree
5	SS	: Very Agree

Data collection technique through observation is used when the research with regard to human behavior, work processes, natural phenomena, as well as the number of respondents who are not too big to be observed [19]. In this research, the

observation was performed to assess the characteristics of Functionality, Reliability, Efficiency, Maintainability, and Portability. However, this observation is not carried out for valuation of Changeability, Stability, and Testability subcharacteristics that exist on Maintainability characteristics. Observations were assessed using BlackBox and Guttman scale is based on each indicator subcharacteristics that have been made.

3.4.5 Determination of Data Analysis Techniques

Once the data collection is completed, the questionnaire and observations data can be processed and converted into numeric form. In the questionnaires, data analysis techniques used are validity and reliability testing. The test is performed using SPSS software version 20. The explanation on the validity and reliability testing of the questionnaire method is as follows:

1. Validity Testing

Validity testing is a step tests performed on the content of an instrument with the aim to measure the instruments accuracy used in a research [19].

In this research, the correlation technique used to test the validity of the statement is Pearson Product Moment Correlation. Instrument be valid if the count is greater coefficient equal to the coefficient table ($r_{hitung} \geq r_{tabel}$).

Instead, the instrument to be invalid if the coefficient count is less than the coefficient table ($r_{hitung} < r_{tabel}$). The categories of instrument validity which refers to the classification validity presented in Table 3.30.

Table 3.30 Category Classification Validity Instruments [19]

Category	Definition
$0.80 < r_{xy} \leq 1.00$	Validity is very high
$0.60 < r_{xy} \leq 0.80$	Validity is high
$0.40 < r_{xy} \leq 0.60$	Validity is sufficient
$0.20 < r_{xy} \leq 0.40$	Validity is low
$0.00 < r_{xy} \leq 0.20$	Validity is very low
$r_{xy} \leq 0.00$	Not valid

Values of r_{xy} in Table 3.30 is the correlation coefficient between the X and Y variables. The results of the questionnaire processing can be known the value and classification validity with significance level of 5%.

2. Reliability Testing

Reliability testing is the process of measuring the accuracy and consistency of an instrument [19]. Reliability testing is done after test the validity of the questionnaire instrument. In this research, Cronbach-Alpha analysis is used to measure the reliability of the statement item questionnaire. The reliability coefficient category described in Table 3.31.

Table 3.31 Category Coefficient Reliability [19]

Category	Definition
$0.80 < r_{11} \leq 1.00$	Reliability is very high
$0.60 < r_{11} \leq 0.80$	Reliability is high
$0.40 < r_{11} \leq 0.60$	Reliability is sufficient
$0.20 < r_{11} \leq 0.40$	Reliability is low
$-1.00 < r_{11} \leq 0.20$	Reliability is very low (not reliable)

Values of r_{11} in Table 3.31 is the reliability coefficient. The results of processing the completed questionnaires by respondents say reliable if the reliability ≥ 0.60 .

If the questionnaire results being tested is valid and reliable, the feasibility percentage can be calculated with the following equation:

$$\text{Feasibility Percentage (\%)} = \frac{\text{Score Observed}}{\text{Score Expected}} \times 100\% \quad (3.3)$$

The results of feasibility percentage will be converted into a Likert scale, as seen in Table 3.32.

Table 3.32 Conversion Feasibility Percentage to Likert Scale

Percentage Feasibility	Interpretation	Likert Scale Score
< 21%	Very Unworthy	1
21% - 40%	Unworthy	2
41% - 60%	Sufficient	3
61% - 80%	Worthy	4
81% - 100%	Very Worthy	5

Likert scale scores obtained in Table 3.32 will be put into variable C which is the score of each subcharacteristic ISO 9126-1 Quality Model. This value is calculated by the formulation of quality software to obtain the value of each characteristic ISO 9126-1 Quality Model.

Meanwhile, the observations made would refer to any valuation indicators of each subcharacteristic ISO 9126-1 Quality Model with the range between 1 until 5, as described in the Indicators Generated of Subcharacteristic ISO 9126-1. Furthermore, the range of values obtained will be put into variable C which is the score of each subcharacteristic ISO 9126-1 Quality Model. It's calculated by the formulation of software quality, so the value of each characteristic ISO 9126-1 Quality Model can be obtained.

3.4.6 Calculation of Value ISO 9126-1 Quality Model

Calculation of value quality instant messenger application will be made after the score of each subcharacteristic ISO 9126-1 Quality Model has been obtained from the results of questionnaire and observations data. Calculation of the total value of each subcharacteristic obtained from the following equation:

$$NSK_m = \frac{W_m}{ST \times C_m} \quad (3.4)$$

Where:

m : Subcharacteristic for m

NSK : Subcharacteristic Value

W_m : Weight of Subcharacteristic for m

ST : Top Scores on Likert Scale (ST = 5)

C_m : Score Value of Questionnaire / Observations Results

Furthermore, each characteristic value is calculated to obtain the overall total of the six characteristics of ISO 9126-1 Quality Model in each instant messenger applications. Calculation of characteristic values obtained from the following equation:

$$NK_n = \sum NSK_m \times BK_n \quad (3.5)$$

$$\sum NSK_m = (W_1 \times C_1) + (W_2 \times C_2) + \dots + (W_m \times C_m) \quad (3.6)$$

Where:

n : Characteristic for n

NK : Characteristic Value

BKM : Weight of Characteristic for m

While, the calculation of the overall total of the six characteristics obtained from the following equation:

$$TNK = \sum NK \quad (3.7)$$

$$\sum NK = NK_1 + NK_2 + \dots + NK_n \quad (3.8)$$

Where:

TNK : Total Value of Characteristic

If the calculation of equation 3.7 has been done, then the percentage of quality of BlackBerry Messenger, WhatsApp, and LINE applications can know the quality of interpretation. The interpretation will generate information whether or not the three popular instant messenger applications such as used by the public.

3.4.7 Comparison of Quality Each Instant Messenger Application

Quality comparison is done after the quality percentage of BlackBerry Messenger, WhatsApp, and LINE applications has been known. The comparative results will be analyzed on the factors that make the first instant messenger applications is superior and worthy than the instant messenger application 2nd and

3rd. In addition, this comparison will prove the suitability of popularity sequence of three popular instant messenger applications on the quality possessed by each application.

4 RESULT & DISCUSSION

The quality of BlackBerry Messenger (BBM), WhatsApp, and LINE application is tested by several methods. These methods are consists of BlackBox Testing, Guttman Scale, and Questionnaire with Likert Scale.

Testing through questionnaire distribution is conducted in two stages. The first stage is questionnaire distribution for determining the weight of characteristic and subcharacteristic ISO 9126-1 Quality Model. While the second stage is questionnaire distribution for measuring the quality of Usability factor for those three popular instant messenger applications in Android operating system.

4.1 Weight Determination Questionnaire Testing

The weight of each characteristic and subcharacteristic is determining with conducted a questionnaire distribution using valuation scale of Analytical Hierarchy Process (AHP) method. The questionnaire distribution for weighting determination is conducted in order to obtain an objective weight order. To generate statistical data accurately and quickly, the respondents answer will be processed using SPSS software version 20 in order to conduct a validity and reliability test.

4.1.1 Respondent Characteristic Analysis

Respondent data that collected in this research questionnaire is forming respondent characteristic. From questionnaire distribution conducted, there are 30 respondent data collected. There a condition that must be fulfilled by the respondent, that is they have to be a mobile based instant messenger application user which has technological background degree (S.Kom dan S.T). This condition made so that respondent who filling out the questionnaire is the respondent who understand the internal and external factor of mobile based instant messenger applications.

Respondent characteristics that existing in this research are including aspect characteristic gender, age, degree, and usage experience (year). Detail percentage of respondent characteristic could be seen in Table 4.1.

Table 4.1 Respondent Characteristic

Characteristics		Frequency	Percentage
Gender	Male	16	53.33%
	Female	14	46.67%
	Total	30	100%
Age	20 - 25 year	30	100%
	Total	30	100%
Degree	S.Kom	21	70%
	S.T	9	30%
	Total	30	100%
Usage Experience (year)	1 year	2	6.67%
	2 year	3	10%
	3 year	6	20%
	4 year	7	23.33%
	5 year	4	13.33%
	6 year	2	6.67%
	7 year	1	3.33%
	8 year	4	13.33%
	9 year	1	3.33%
	Total	30	100%

Table 4.1 shows that 53.33% respondents are male and 46.67% respondents are female. This respondent characteristic shows the valuation given by the respondent that filling out the questionnaire is can be trusted. It is due to 100% maturity age aspect range of the respondent in between 20 – 25 years. In degree aspect, 70% respondents have Bachelor of Computer Science degree (S.Kom) and 30% respondents have Bachelor of Engineering degree (S.T) with Informatics Engineering Department. While in usage experience aspect, a various answer by the respondent is appear in between 1 - 9 years usage experience. From that range (1 – 9 years), 23.33% respondent is using mobile based instant messenger application for 4 years.

This questionnaire has 7 variables that asked to the respondent in order to comparing the instruments in each variable. Those seventh variables are ISO 9126-1 Quality Model variable, Functionality Subcharacteristic, Reliability Subcharacteristic, Usability Subcharacteristic, Efficiency Subcharacteristic, Maintainability Subcharacteristic, and Portability Subcharacteristic. The respondents have to answer each variable question in between 1 – 9 range.

ISO 9126-1 Quality Model Variable is a comparison variable between Functionality, Reliability, Usability, Efficiency, Maintainability and Portability characteristics. From 30 respondents that filling out the questionnaire, modus valuation from all respondent answer toward ISO 9126-1 Quality Model variable is could be seen in Table 4.2.

Table 4.2 Respondent Answer toward ISO 9126-1 Quality Model Variable

Number of Questions (a) more important than (b)	Respondent Answer									Frequency	Modus	
	1	2	3	4	5	6	7	8	9			
1	(a) Functionality (b) Reliability	3	2	8	1	6	0	5	1	4	30	3
2	(a) Functionality (b) Usability	9	3	2	1	9	1	3	2	0	30	1 & 5
3	(a) Functionality (b) Efficiency	5	1	3	2	6	1	4	4	4	30	5
4	(a) Functionality (b) Maintainability	6	1	5	3	4	0	1	2	8	30	9
5	(a) Functionality (b) Portability	7	2	4	1	4	2	7	1	2	30	1 & 7
6	(a) Reliability (b) Usability	7	2	4	2	8	0	4	1	2	30	5
7	(a) Reliability (b) Efficiency	11	1	2	0	5	1	2	0	8	30	1
8	(a) Reliability (b) Maintainability	6	0	3	1	7	2	4	3	4	30	5
9	(a) Reliability (b) Portability	7	2	3	0	6	1	8	0	3	30	7
10	(a) Usability (b) Efficiency	7	0	3	1	7	1	6	3	2	30	1 & 5
11	(a) Usability (b) Maintainability	7	4	5	1	9	0	1	0	3	30	5
12	(a) Usability (b) Portability	8	3	2	1	6	0	6	2	2	30	1
13	(a) Efficiency (b) Maintainability	3	2	4	0	8	0	5	1	7	30	5
14	(a) Efficiency (b) Portability	9	4	1	0	5	0	4	3	4	30	1
15	(a) Maintainability (b) Portability	10	1	3	0	3	1	5	2	5	30	1

Table 4.2 shows that modus obtained from each question including range 1 (Equally Important), 3 (Abit More Important), 5 (More Important), 7 (Extremely More Important), and 9 (Absolutely More Important). Majority of respondents are agreeing if Functionality characteristic is more important than Reliability, Efficiency, and Maintainability characteristics. The respondent also be opting a Reliability characteristic is more important that Usability, Maintainability, and

Portability characteristics. Besides, Usability and Efficiency characteristics also considered to be more important than Maintainability characteristic.

Functionality subcharacteristic variable is a comparison variable between Suitability, Accuracy, Security, Interoperability, and Functionality Compliance subcharacteristics. The modus valuation from all respondent answer toward Functionality subcharacteristic variable is could be seen in Table 4.3.

Table 4.3 Respondent Answer toward Functionality Subcharacteristic Variable

Number of Questions (a) more important than (b)	Respondent Answer									Frequency	Modus
	1	2	3	4	5	6	7	8	9		
1 (a) Suitability (b) Accuracy	14	1	1	0	5	0	5	1	3	30	1
2 (a) Suitability (b) Security	7	2	6	1	4	1	7	0	2	30	1 & 7
3 (a) Suitability (b) Interoperability	4	6	4	0	4	1	5	2	4	30	2
4 (a) Suitability (b) F. Compliance	11	2	4	0	5	0	3	4	1	30	1
5 (a) Accuracy (b) Security	11	0	6	0	3	1	1	5	3	30	1
6 (a) Accuracy (b) Interoperability	4	4	5	0	8	1	3	1	4	30	5
7 (a) Accuracy (b) F. Compliance	11	3	5	1	4	1	2	2	1	30	1
8 (a) Security (b) Interoperability	5	1	5	0	10	0	3	2	4	30	5
9 (a) Security (b) F. Compliance	10	4	1	1	4	0	3	3	4	30	1
10 (a) Interoperability (b) F. Compliance	10	1	4	2	5	0	3	4	1	30	1

Table 4.3 shows that modus obtained from each question including range 1 (Equally Important), 2 (Between Equally Important and Abit More Important), 5 (More Important), and 7 (Extremely More Important). Majority of respondents are agreeing if Suitability, Accuracy, and Security subcharacteristics are more important than Interoperability subcharacteristic.

Reliability subcharacteristic variable is a comparison variable between Maturity, Fault Tolerance, Recoverability, and Reliability Compliance subcharacteristics. The modus valuation from all respondent answer toward Reliability subcharacteristic variable is could be seen in Table 4.4.

Table 4.4 Respondent Answer toward Reliability Subcharacteristic Variable

Number of Questions (a) more important than (b)	Respondent Answer									Frequency	Modus
	1	2	3	4	5	6	7	8	9		
1 (a) Maturity (b) Fault Tolerance	11	1	6	0	5	1	2	0	4	30	1
2 (a) Maturity (b) Recoverability	3	9	3	0	2	2	6	2	3	30	2
3 (a) Maturity (b) R. Compliance	10	4	6	0	4	0	3	2	1	30	1
4 (a) Fault Tolerance (b) Recoverability	6	9	2	0	2	3	4	2	2	30	2
5 (a) Fault Tolerance (b) R. Compliance	11	0	2	0	4	1	4	3	5	30	1
6 (a) Recoverability (b) R. Compliance	7	1	6	0	4	1	3	2	6	30	1

Table 4.4 shows that modus obtained from each question including range 1 (Equally Important) and 2 (Between Equally Important and Abit More Important). Majority of respondents are agreeing if Maturity and Fault Tolerance subcharacteristics are more important than Recoverability subcharacteristic.

Usability subcharacteristic variable is a comparison variable between Understandability, Learnability, Operability, Attractiveness, and Usability Compliance subcharacteristics. The modus valuation from all respondent answer toward Usability subcharacteristic variable is could be seen in Table 4.5.

Table 4.5 Respondent Answer toward Usability Subcharacteristic Variable

Number of Questions (a) more important than (b)	Respondent Answer									Frequency	Modus
	1	2	3	4	5	6	7	8	9		
1 (a) Understandability (b) Learnability	15	1	2	1	4	1	3	1	2	30	1
2 (a) Understandability (b) Operability	12	3	1	2	3	0	7	1	1	30	1
3 (a) Understandability (b) Attractiveness	7	1	5	3	6	2	5	0	1	30	1
4 (a) Understandability (b) U. Compliance	9	5	2	1	3	2	4	3	1	30	1
5 (a) Learnability (b) Operability	12	3	2	1	0	0	10	2	0	30	1
6 (a) Learnability (b) Attractiveness	3	7	4	2	4	2	6	1	1	30	2
7 (a) Learnability (b) U. Compliance	7	3	6	0	4	0	5	2	3	30	1
8 (a) Operability (b) Attractiveness	5	3	6	0	5	2	5	3	1	30	3
9 (a) Operability (b) U. Compliance	8	1	9	2	5	0	5	0	0	30	3
10 (a) Attractiveness (b) U. Compliance	2	4	7	0	5	1	5	4	2	30	3

Table 4.5 shows that modus obtained from each question including range 1 (Equally Important), 2 (Between Equally Important and Abit More Important), and 3 (Abit More Important). Majority of respondents are agreeing if Understandability, Learnability, Operability, and Attractiveness subcharacteristics are have an equally important role to each other. However, the respondent also be opting if Learnability and Operability subcharacteristics are more important than Attractiveness subcharacteristic. While Operability and Attractiveness subcharacteristics are considered to be more important than Usability Compliance.

Efficiency subcharacteristic variable is a comparison variable between Time Behaviour, Resource Utilization, and Efficiency Compliance subcharacteristics.

The modus valuation from all respondent answer toward Efficiency subcharacteristic variable is could be seen in Table 4.6.

Table 4.6 Respondent Answer toward Efficiency Subcharacteristic Variable

Number of Questions (a) more important than (b)	Respondent Answer									Frequency	Modus
	1	2	3	4	5	6	7	8	9		
1 (a) Time Behaviour (b) Resource Utilization	8	0	4	2	5	0	3	3	5	30	1
2 (a) Time Behaviour (b) E. Compliance	10	1	4	1	6	1	2	4	1	30	1
3 (a) Resource Utilization (b) E. Compliance	8	4	3	2	4	1	0	4	4	30	1

Table 4.6 shows that modus obtained from each questions is in range 1 (Equally Important). Majority of respondents are agreeing if Time Behaviour, Resource Utilization, and Efficiency Compliance subcharacteristics are have an equally important role to each other.

Maintainability subcharacteristic variable is a comparison variable between Analyzability and Maintainability Compliance subcharacteristics. The modus valuation from all respondent answer toward Maintainability subcharacteristic variable is could be seen in Table 4.7.

Table 4.7 Respondent Answer toward Maintainability Subcharacteristic Variable

Number of Questions (a) more important than (b)	Respondent Answer									Frequency	Modus
	1	2	3	4	5	6	7	8	9		
1 (a) Analyzability (b) M. Compliance	11	1	4	0	5	0	4	2	3	30	1

Table 4.7 shows that modus obtained from each questions is in range 1 (Equally Important). Majority of respondents are agreeing if Analyzability and

Maintainability Compliance subcharacteristics are have an equally important role to each other.

Portability subcharacteristic variable is a comparison variable between Adaptability, Installability, Coexistence, Replaceability, and Portability Compliance subcharacteristics. The modus valuation from all respondent answer toward Portability subcharacteristic variable is could be seen in Table 4.8.

Table 4.8 Respondent Answer toward Portability Subcharacteristic Variable

(a) more important than (b)	Respondent Answer									Frequency	Modus
	1	2	3	4	5	6	7	8	9		
1 (a) Adaptability (b) Installability	11	3	5	3	5	0	1	1	1	30	1
2 (a) Adaptability (b) Coexistence	4	8	3	0	4	2	5	0	4	30	2
3 (a) Adaptability (b) Replaceability	2	8	6	1	2	2	5	1	3	30	2
4 (a) Adaptability (b) P. Compliance	9	3	5	2	3	0	2	5	1	30	1
5 (a) Installability (b) Coexistence	7	0	3	1	3	2	9	0	5	30	7
6 (a) Installability (b) Replaceability	5	6	3	2	1	1	5	1	6	30	2 & 9
7 (a) Installability (b) P. Compliance	11	4	3	2	0	1	4	4	1	30	1
8 (a) Coexistence (b) Replaceability	9	2	3	2	5	2	2	2	3	30	1
9 (a) Coexistence (b) P. Compliance	9	3	6	1	3	0	2	4	2	30	1
10 (a) Replaceability (b) P. Compliance	10	2	3	1	4	0	2	4	4	30	1

Table 4.8 shows that modus obtained from each question including range 1 (Equally Important), 2 (Between Equally Important and Abit More Important), 7 (Extremely More Important), and 9 (Absolutely More Important). Majority of respondents are agreeing if Adaptability and Installability subcharacteristics are more important than Coexistence and Replaceability subcharacteristics.

Modus valuation that obtained from each variable will be used to process ISO 9126-1 Quality Model characteristic and subcharacteristic weighting with BPMSG AHP Priority Calculator tools. This modus valuation will be a choice for pairwise comparison with Consistency Ratio (CR) result is less than 10%.

4.1.2 Variable Validity Testing

The questionnaire in this research have to fulfill the validity and reliability conditions. The validity test conducted in order to find out the data instrument accuracy that filled out by the respondent. Pearson Product Moment correlation technique is the technique used for correlating each variable score with total variable score. The correlation result will be compared with critical value in 0.01 significant level which has 99% confidence level and 0.05 significant level which has 95% confidence level. In SPSS software, the 0.01 significant level marked with 2 flags (**), while the 0.05 significant level marked with 1 flag (*). In this research, the instrument in each variable that will be conducted a validity test is the instrument in ISO 9126-1 Quality Model, Functionality Subcharacteristic, Reliability Subcharacteristic, Usability Subcharacteristic, Efficiency Subcharacteristic, Maintainability Subcharacteristic, and Portability Subcharacteristic variable.

ISO 9126-1 Quality Model variable has 15 instruments that will be conducted the validity test. The validity test result toward ISO 9126-1 Quality Model variable instrument could be seen in Table 4.9.

Table 4.9 ISO 9126-1 Quality Model Variable Instrument Validity Test Result

Instrument	r_{xy}	Significant	r_{tabel}	Category
ISO01	0.593**	0.01	0.463	Moderate Validity
ISO02	0.759**	0.01	0.463	High Validity
ISO03	0.749**	0.01	0.463	High Validity
ISO04	0.737**	0.01	0.463	High Validity
ISO05	0.857**	0.01	0.463	Very High Validity
ISO06	0.792**	0.01	0.463	High Validity
ISO07	0.837**	0.01	0.463	Very High Validity
ISO08	0.808**	0.01	0.463	Very High Validity
ISO09	0.822**	0.01	0.463	Very High Validity
ISO10	0.691**	0.01	0.463	High Validity
ISO11	0.811**	0.01	0.463	Very High Validity
ISO12	0.804**	0.01	0.463	Very High Validity
ISO13	0.677**	0.01	0.463	High Validity
ISO14	0.830**	0.01	0.463	Very High Validity
ISO15	0.699**	0.01	0.463	High Validity

Table 4.9 shows that r_{xy} value from r_{hitung} has a higher value than r_{tabel} . The r_{tabel} value in each instrument obtained from r_{tabel} Product Moment distribution with 0.01 significant level and 30 respondent population measure (N). Based on coefficient validity category, all instruments in ISO 9126-1 Quality Model variable are valid with each classification levels. The instrument that counted as a moderate validity is only ISO01 instrument. While the instruments that counted as high validity are ISO02, ISO03, ISO04, ISO06, ISO10, ISO13, and ISO15 instrument. The instruments that counted as very high validity are ISO05, ISO07, ISO08, ISO09, ISO11, ISO12, and ISO14 instrument. It shows that all the instruments which measured produce an accurate and credible data with minimum standard of 0.593 r_{xy} value and 99% confidence level.

Functionality subcharacteristic variable has 10 instruments that will be conducted the validity test. The validity test result toward Functionality subcharacteristic variable instrument could be seen in Table 4.10.

Table 4.10 Functionality Subcharacteristic Variable Instrument Validity Test Result

Instrument	r_{xy}	Significant	r_{tabel}	Category
SF01	0.745**	0.01	0.463	High Validity
SF02	0.766**	0.01	0.463	High Validity
SF03	0.736**	0.01	0.463	High Validity
SF04	0.810**	0.01	0.463	Very High Validity
SF05	0.633**	0.01	0.463	High Validity
SF06	0.705**	0.01	0.463	High Validity
SF07	0.743**	0.01	0.463	High Validity
SF08	0.508**	0.01	0.463	Moderate Validity
SF09	0.687**	0.01	0.463	High Validity
SF10	0.644**	0.01	0.463	High Validity

Table 4.10 shows that r_{xy} value from r_{hitung} has a higher value than r_{tabel} . The r_{tabel} value in each instrument obtained from r_{tabel} Product Moment distribution with 0.01 significant level and 30 respondent population measure (N). Based on coefficient validity category, all instruments in Functionality subcharacteristic variable are valid with each classification levels. The instrument that counted as a moderate validity is only SF08 instrument and SF04 counted as a very high validity. While the instruments that counted as high validity are SF01, SF02, SF03, SF05, SF06, SF07, SF09, and SF10 instrument. It shows that all the instruments which measured are produce an accurate and credible data with minimum standard of 0.508 r_{xy} value and 99% confidence level.

Reliability subcharacteristic variable has 6 instruments that will be conducted the validity test. The validity test result toward Reliability subcharacteristic variable instrument could be seen in Table 4.11.

Table 4.11 Reliability Subcharacteristic Variable Instrument Validity Test Result

Instrument	r_{xy}	Significant	r_{tabel}	Category
SR01	0.713**	0.01	0.463	High Validity
SR02	0.763**	0.01	0.463	High Validity
SR03	0.753**	0.01	0.463	High Validity

Instrument	r_{xy}	Significant	r_{tabel}	Category
SR04	0.683**	0.01	0.463	High Validity
SR05	0.722**	0.01	0.463	High Validity
SR06	0.804**	0.01	0.463	Very High Validity

Table 4.11 shows that r_{xy} value that form r_{hitung} has a higher value than r_{tabel} . The r_{tabel} value in each instrument obtained from r_{tabel} Product Moment distribution with 0.01 significant level and 30 respondent population measure (N). Based on coefficient validity category, all instruments in Reliability subcharacteristic variable are valid with each classification levels. The instrument that counted as a very high validity is only SR06 instrument, while the instruments that counted as high validity are SR01, SR02, SR03, SR04, and SR05 instrument. It is shows that all the instruments which measured are produce an accurate and credible data with minimum standard of 0.683 r_{xy} value and 99% confidence level.

Usability subcharacteristic variable has 10 instruments that will be conducted the validity test. The validity test result toward Usability subcharacteristic variable instrument could be seen in Table 4.12.

Table 4.12 Usability Subcharacteristic Variable Instrument Validity Test Result

Instrument	r_{xy}	Significant	r_{tabel}	Category
SU01	0.709**	0.01	0.463	High Validity
SU02	0.787**	0.01	0.463	High Validity
SU03	0.823**	0.01	0.463	Very High Validity
SU04	0.692**	0.01	0.463	High Validity
SU05	0.811**	0.01	0.463	Very High Validity
SU06	0.700**	0.01	0.463	High Validity
SU07	0.664**	0.01	0.463	High Validity
SU08	0.726**	0.01	0.463	High Validity
SU09	0.420*	0.05	0.361	Moderate Validity
SU10	0.623**	0.01	0.463	High Validity

Table 4.12 shows that r_{xy} value that form r_{hitung} has a higher value than r_{tabel} . The r_{tabel} value in each instrument obtained from r_{tabel} Product Moment distribution with 0.01 significant level and 30 respondent population measure (N). However, r_{tabel} value in SU09 instrument that obtained from r_{tabel} Product Moment distribution is at 0.05 significant levels. Based on coefficient validity category, all instruments in Usability subcharacteristic variable are valid with each classification levels. The instruments that counted as very high validity are SU03 and SU05, while the instruments that counted as high validity are SU01, SU02, SU04, SU06, SU07, SU08, and SU10 instrument. While, SU09 instrument is counted as a moderate validity. It is shows that all the instruments which measured are still produce an accurate and credible data, although with minimum standard of 0.420 r_{xy} value and 95% confidence level.

Efficiency subcharacteristic variable has 3 instruments that will be conducted the validity test. The validity test result toward Efficiency subcharacteristic variable instrument could be seen in Table 4.13.

Table 4.13 Efficiency Subcharacteristic Variable Instrument Validity Test Result

Instrument	r_{xy}	Significant	r_{tabel}	Category
SE01	0.793**	0.01	0.463	High Validity
SE02	0.868**	0.01	0.463	Very High Validity
SE03	0.842**	0.01	0.463	Very High Validity

Table 4.13 shows that r_{xy} value that form r_{hitung} has a higher value than r_{tabel} . The r_{tabel} value in each instrument obtained from r_{tabel} Product Moment distribution with 0.01 significant level and 30 respondent population measure (N). Based on coefficient validity category, all instruments in Efficiency subcharacteristic variable

are valid with each classification levels. The instrument that counted as a high validity is only SE06 instrument, while the instruments that counted as very high validity are SE02, and SE03 instrument. It shows that all the instruments which measured are produce an accurate and credible data with minimum standard of 0.793 r_{xy} value and 99% confidence level.

Maintainability subcharacteristic variable has 1 instrument that will be conducted the validity test. The validity test result toward Maintainability subcharacteristic variable instrument could be seen in Table 4.14.

Table 4.14 Maintainability Subcharacteristic Variable Validity Test Result

Instrument	r_{xy}	Significant	r_{tabel}	Category
SM01	1.000**	0.01	0.463	Validitas Sangat Tinggi

Table 4.14 shows that r_{xy} value that form r_{hitung} has a higher value than r_{tabel} . The r_{tabel} value in each instrument obtained from r_{tabel} Product Moment distribution with 0.01 significant level and 30 respondent population measure (N). Based on coefficient validity category, SM01 instrument in Maintainability subcharacteristic variable has a perfect and very high validity. It shows that the instrument which measured is produce an accurate and credible data with minimum standard of 1.000 r_{xy} value and 99% confidence level.

Portability subcharacteristic variable has 10 instrument that will be conducted the validity test. The validity test result toward Portability subcharacteristic variable instrument could be seen in Table 4.15.

Table 4.15 Portability Subcharacteristic Variable Instrument Validity Test Result

Instrument	r_{xy}	Significant	r_{tabel}	Category
SP01	0.590**	0.01	0.463	Moderate Validity
SP02	0.697**	0.01	0.463	High Validity
SP03	0.821**	0.01	0.463	Very High Validity
SP04	0.719**	0.01	0.463	High Validity
SP05	0.765**	0.01	0.463	High Validity
SP06	0.757**	0.01	0.463	High Validity
SP07	0.820**	0.01	0.463	Very High Validity
SP08	0.589**	0.01	0.463	Moderate Validity
SP09	0.777**	0.01	0.463	High Validity
SP10	0.768**	0.01	0.463	High Validity

Table 4.15 shows that r_{xy} value from r_{hitung} has a higher value than r_{tabel} . The r_{tabel} value in each instrument obtained from r_{tabel} Product Moment distribution with 0.01 significant level and 30 respondent population measure (N). Based on coefficient validity category, all instruments in Portability subcharacteristic variable are valid with each classification levels. The instruments that counted as moderate validity are SP01 and SP08 instrument, while SP03 and SP07 instrument are counted as very high validity. While the instruments that counted as high validity are SP02, SP04, SP05, SP06, SP09, and SP10 instrument. It shows that all the instruments which measured are produces an accurate and credible data with minimum standard of 0.589 r_{xy} value and 99% confidence level.

4.1.3 Variable Reliability Testing

After the validity test conducted, reliability of each variable also being tested. This testing conducted to measuring the precision and consistency score for each instrument that filled out by respondent. The precision and consistency score will be found out from Cronbach-Alpha value which then converted to reliability

coefficient category. Reliability testing result toward each variable could be seen in Table 4.16.

Table 4.16 Reliability Test Result for Each Variable

Variabel	Cronbach Alpha (r ₁₁)	Total Instrument	Category
ISO 9126-1 Quality Model	0.769	15	High Reliability
Functionality Subcharacteristic	0.767	10	High Reliability
Reliability Subcharacteristic	0.786	6	High Reliability
Usability Subcharacteristic	0.768	10	High Reliability
Efficiency Subcharacteristic	0.837	3	Very High Reliability
Maintainability Subcharacteristic	1.000	1	Very High Reliability
Portability Subcharacteristic	0.773	10	High Reliability

Table 4.16 shows that r₁₁ value which is Cronbach-Alpha reliability coefficient gives a reliable result with 30 respondents population measure (N). The result for each variable has each category level of reliability. Variable that counted as high validity are ISO Quality Model with 15 instruments, Functionality Subcharacteristic with 10 instruments, Reliability Subcharacteristic with 6 instruments, Usability Subcharacteristic with 10 instruments, and Portability Subcharacteristic with 10 instruments variable. While the variable that counted as very high validity are Efficiency Subcharacteristic with 3 instruments and Maintainability Subcharacteristic with 1 instrument variable. It is shows that all variables which measured are produces an accurate and credible data with minimum standard of 0.767 r₁₁ value.

4.2 Usability Characteristic Application Quality Questionnaire Testing

Quality measurement of BlackBerry Messenger (BBM), WhatsApp, and LINE applications in Usability characteristic determined by conducted a

questionnaire distribution using Likert scale. The questionnaire distribution is conducted in order to obtain an objective result of those three popular applications quality. To generate statistical data accurately and quickly, the respondents answer will be processed using SPSS software version 20 in order to conduct a validity and reliability test.

4.2.1 Respondent Characteristic Analysis

Respondent data that collected in this research questionnaire is forming respondent characteristic. From questionnaire distribution conducted, there are 204 respondent data collected. The total of respondent is comes from calculation of sample measurement by using Slovin formula with 0.07 or 7% error level and 93% confidence level. There a condition that must be fulfilled by the respondent, that is they have to be an Android mobile based smartphone user which using BlackBerry Messenger (BBM), WhatsApp, and LINE applications. This condition made so that respondent who filling out the questionnaire is the respondent who understand those instant messenger applications utility.

Respondent characteristics that existing in this research are including aspect characteristic gender, age, domicile (province), smartphone type, and Android version. Detail percentage of respondent characteristic could be seen in Table 4.17.

Table 4.17 Respondent Characteristic

Characteristics		Frequency	Percentage
Gender	Male	107	52.45%
	Female	97	47.55%
	Total	204	100%
Age	≤ 17 year	8	3.92%
	18 - 25 year	179	87.75%
	26 - 35 year	15	7.35%
	36 - 45 year	2	0.98%
	Total	204	100%
Domicile (Province)	DKI Jakarta	13	6.37%
	NAD (Aceh)	9	4.41%
	Sumatera Utara	7	3.43%
	Sumatera Barat	6	2.94%
	Sumatera Selatan	1	0.49%
	Riau	2	0.98%
	Jambi	1	0.49%
	Lampung	5	2.45%
	Bengkulu	4	1.96%
	Kep. Bangka Belitung	2	0.98%
	DIY (Yogyakarta)	16	7.84%
	Jawa Barat	66	32.35%
	Jawa Tengah	24	11.76%
	Jawa Timur	21	10.29%
	Banten	7	3.43%
	Bali	6	2.94%
	NTT	2	0.98%
	NTB	1	0.49%
	Kalimantan Barat	2	0.98%
	Kalimantan Selatan	2	0.98%
	Kalimantan Timur	1	0.49%
	Sulawesi Selatan	1	0.49%
	Sulawesi Barat	1	0.49%
	Gorontalo	1	0.49%
	Maluku	2	0.98%
	Papua	1	0.49%
Total		204	100%
Smartphone Type	Samsung	74	36.27%
	Sony	29	14.22%
	Smartfren	22	10.78%
	Acer	2	0.98%
	Xiaomi	6	2.94%
	LG	11	5.39%
	Lenovo	9	4.41%
	Oppo	16	7.84%
	Asus	23	11.27%
	Polytron	1	0.49%
	Himax	1	0.49%
	Innos	1	0.49%
	Nokia	3	1.47%

Characteristics		Frequency	Percentage
Smartphone Type	Mito	1	0.49%
	IMO	2	0.98%
	Alcatel	1	0.49%
	Axioo	1	0.49%
	Advan	1	0.49%
	Total	204	100%
Android Version	Android 2.3 - 2.3.7 Gingerbread	13	6.37%
	Android 4.1 - 4.3 Jelly Bean	119	58.33%
	Android 4.0 - 4.0.4 Ice Cream Sandwich	15	7.35%
	Android 4.4 KitKat	51	25%
	Android 5.0 Lollipop	6	2.94%
	Total	204	100%

Table 4.1 shows that 52.45% respondents are male and 47.55% respondents are female. Based on respondent characteristic obtained, questionnaire filling to evaluate BlackBerry Messenger (BBM), WhatsApp, and LINE application quality that given by the respondent is can be trusted. It is due to the highest percentage of maturity age aspect range of the respondent in between 18 – 25 years is 87.75%. Besides, from respondent domicile aspect who filled out this questionnaire, there are 26 of 34 province obtained. From 204 respondents, 32.35 % of respondent which is the highest percentage, are live in Jawa Barat Province. While the lowest percentage of respondent domicile are comes from Jambi, Sumatera Selatan, Nusa Tenggara Barat (NTB), Kalimantan Timur, Sulawesi Selatan, Sulawesi Barat, Gorontalo, and Papua which is only 0.49%.

There are various types of smartphone and Android version that used to evaluate the respondent characteristic. From the smartphone type aspect, 36.27% of respondents are using Samsung smartphone type and 0.49% of respondents are using Polytron, Himax, Innos, Mito, Alcatel, Axioo, and Advan smartphone type.

While from Android version aspect, 58.33% of respondents using Jelly Bean Android version, 25% of respondents using KitKat Android version, 7.35% of respondent using Ice Cream Sandwich Android version, 6.37% of respondents using Gingerbread Android version, and 2.94% of respondent using Lollipop Android version. Based on those percentages, all three popular instant messenger applications could be running in various smartphones type and Android version are known.

This questionnaire has 5 variables that asked to the respondent in order to evaluates the utility aspect. Those fifth variables are Understandability, Learnability, Operability, Attractiveness, and Usability Compliance variable. The respondents have to answer each variable question with Very Disagree (STS), Disagree (TS), Neutral (N), Agree (S), and Very Agree (SS).

Understandability variable is a variable that concern about user easiness statement in understanding BlackBerry Messenger (BBM), WhatsApp, and LINE applications. Feasibility percentage from all respondents answer toward Understandability variable could be seen in Table 4.18.

Table 4.18 Respondents Answer toward Understandability Variable

Instrument	Respondent Answer Frequency					Total Respondent
	STS	TS	N	S	SS	
BlackBerry Messenger (BBM)						
UB01	8	14	35	106	41	204
UB02	5	14	36	108	41	204
UB03	6	13	39	109	37	204
Total Answer	19	41	110	323	119	612
Percentage	3.10%	6.70%	17.97%	52.78%	19.44%	100%

Instrument	Respondent Answer Frequency					Total Respondent
	STS	TS	N	S	SS	
WhatsApp Messenger						
UW01	5	0	22	96	81	204
UW02	3	4	16	84	97	204
UW03	3	5	20	105	71	204
Total Answer	11	9	58	285	249	612
Percentage	1.80%	1.47%	9.48%	46.57%	40.69%	100%
LINE Messenger						
UL01	6	7	33	104	54	204
UL02	4	11	34	90	65	204
UL03	4	11	29	104	56	204
Total Answer	14	29	96	298	175	612
Percentage	2.29%	4.74%	15.69%	48.69%	28.59%	100%

Table 4.18 shows that respondent are agree toward the user easiness in understanding those three popular instant messenger applications. From 204 respondents, 52.78% of respondents are agreeing if BlackBerry Messenger (BBM) application is easy to understand, 46.57% of respondents are agreeing if WhatsApp application is easy to understand, and 48.69% of respondents are agreeing if LINE application is easy to understand.

Learnability variable is a variable that concern about user easiness statement in learning BlackBerry Messenger (BBM), WhatsApp, and LINE applications. Feasibility percentage from all respondents answer toward Learnability variable could be seen in Table 4.19.

Table 4.19 Respondents Answer toward Learnability Variable

Instrument	Respondent Answer Frequency					Total Respondent
	STS	TS	N	S	SS	
BlackBerry Messenger (BBM)						
LB01	5	11	25	101	62	204
LB02	4	13	45	108	34	204
Total Answer	9	24	70	209	96	408
Percentage	2.21%	5.88%	17.16%	51.23%	23.53%	100%

Instrument	Respondent Answer Frequency					Total Respondent
	STS	TS	N	S	SS	
WhatsApp Messenger						
LW01	2	3	12	81	106	204
LW02	2	4	24	119	55	204
Total Answer	4	7	36	200	161	408
Percentage	0.98%	1.72%	8.82%	49.02%	39.46%	100%
LINE Messenger						
LL01	4	6	27	100	67	204
LL02	4	6	37	111	46	204
Total Answer	8	12	64	211	113	408
Percentage	1.96%	2.94%	15.69%	51.72%	27.70%	100%

Table 4.19 shows that respondent are agree toward the user easiness in learning those three popular instant messenger applications. From 204 respondents, 51.72% of respondents are agreeing if LINE application is easy to learn, 51.23% of respondents are agreeing if BlackBerry Messenger (BBM) application is easy to learn, and 49.02% of respondents are agreeing if WhatsApp application is easy to learn.

Operability variable is a variable that concern about user easiness statement in operating BlackBerry Messenger (BBM), WhatsApp, and LINE applications. Feasibility percentage from all respondents answer toward Operability variable could be seen in Table 4.20.

Table 4.20 Respondents Answer toward Operability Variable

Instrument	Respondent Answer Frequency					Total Respondent
	STS	TS	N	S	SS	
BlackBerry Messenger (BBM)						
OB01	13	44	73	64	10	204
OB02	10	25	79	76	14	204
OB03	6	22	54	84	38	204
OB04	3	16	49	97	39	204
Total Answer	32	107	255	321	101	816
Percentage	3.92%	13.11%	31.25%	39.34%	12.38%	100%

Instrument	Respondent Answer Frequency					Total Respondent
	STS	TS	N	S	SS	
WhatsApp Messenger						
OW01	6	29	60	80	29	204
OW02	3	10	61	99	31	204
OW03	6	8	39	101	50	204
OW04	4	2	32	91	75	204
Total Answer	19	49	192	371	185	816
Percentage	2.33%	6%	23.53%	45.47%	22.67%	100%
LINE Messenger						
OL01	7	37	64	70	26	204
OL02	4	20	75	84	21	204
OL03	5	14	47	93	45	204
OL04	3	13	48	92	48	204
Total Answer	19	84	234	339	140	816
Percentage	2.33%	10.29%	28.68%	41.54%	17.16%	100%

Table 4.20 shows that respondent are agree toward the user easiness in operating those three popular instant messenger applications. From 204 respondents, 45.47% of respondents are agreeing if WhatsApp application is easy to operate, 41.54% of respondents are agreeing if LINE application is easy to operate, and 39.34% of respondents are agreeing if BlackBerry Messenger (BBM) application is easy to operate.

Attractiveness variable is a variable that concern about user easiness statement in attraction of BlackBerry Messenger (BBM), WhatsApp, and LINE applications. Feasibility percentage from all respondents answer toward Attractiveness variable could be seen in Table 4.21.

Table 4.21 Respondents Answer toward Attractiveness Variable

Instrument	Respondent Answer Frequency					Total Respondent
	STS	TS	N	S	SS	
BlackBerry Messenger (BBM)						
AB01	10	16	58	77	43	204
AB02	8	19	50	95	32	204
AB03	8	18	40	101	37	204
AB04	10	15	53	84	42	204
Total Answer	36	68	201	357	154	816
Percentage	4.41%	8.33%	24.63%	43.75%	18.87%	100%
WhatsApp Messenger						
AW01	4	2	24	100	74	204
AW02	3	5	30	114	52	204
AW03	4	1	19	102	78	204
AW04	3	7	41	92	61	204
Total Answer	14	15	114	408	265	816
Percentage	1.72%	1.84%	13.97%	50%	32.48%	100%
LINE Messenger						
AL01	7	16	34	71	76	204
AL02	6	10	34	99	55	204
AL03	5	11	27	112	49	204
AL04	6	12	39	83	64	204
Total Answer	24	49	134	365	244	816
Percentage	2.94%	6%	16.42%	44.73%	29.90%	100%

Table 4.22 shows that respondent are agree toward the attraction of those three popular instant messenger applications. From 204 respondents, 50% of respondents are agreeing if WhatsApp application is attracting, 44.73% of respondents are agreeing if LINE application is attracting, and 43.75% of respondents are agreeing if BlackBerry Messenger (BBM) application is attracting.

Usability Compliance variable is a variable that concern about BlackBerry Messenger (BBM), WhatsApp, and LINE standard applications statement. Feasibility percentage from all respondents answer toward Usability Compliance variable could be seen in Table 4.22.

Table 4.22 Respondents Answer toward Usability Compliance Variable

Instrument	Respondent Answer Frequency					Total Respondent
	STS	TS	N	S	SS	
BlackBerry Messenger (BBM)						
UCB01	7	19	51	95	32	204
UCB02	10	20	45	88	41	204
UCB03	8	20	47	95	34	204
UCB04	8	25	59	85	27	204
UCB05	5	30	67	81	21	204
UCB06	9	22	46	106	21	204
Total Answer	47	136	315	550	176	1224
Percentage	3.84%	11.11%	25.74%	44.93%	14.38%	100%
WhatsApp Messenger						
UCW01	4	5	28	93	74	204
UCW02	5	2	25	90	82	204
UCW03	3	3	30	98	70	204
UCW04	5	5	55	84	55	204
UCW05	4	16	55	91	38	204
UCW06	2	4	38	98	62	204
Total Answer	23	35	231	554	381	1224
Percentage	1.88%	2.86%	18.87%	45.26%	31.13%	100%
LINE Messenger						
UCL01	6	14	44	93	47	204
UCL02	8	9	55	86	46	204
UCL03	7	13	51	87	46	204
UCL04	8	16	72	72	36	204
UCL05	4	18	59	83	40	204
UCL06	3	12	46	98	45	204
Total Answer	36	82	327	519	260	1224
Percentage	2.94%	6.70%	26.72%	42.40%	21.24%	100%

Table 4.22 shows that respondent are agree toward the suitability standard that three popular instant messenger applications possessed. From 204 respondents, 45.26% of respondents are agreeing if WhatsApp application is has a suitable standard, 44.93% of respondents are agreeing if BlackBerry Messenger (BBM) application is has a suitable standard, and 42.40% of respondents are agreeing if WhatsApp application is also has a suitable standard.

The highest percentage value will be selected from each scale to obtain a feasibility percentage. That highest percentage will be converted in valuation indicator for each subcharacteristic in Usability characteristic. This process will refer to BlackBerry Messenger (BBM), WhatsApp, and LINE applications quality category from Usability aspect.

4.2.2 Variable Validity Testing

The questionnaire in this research have to fulfill the validity and reliability conditions. The validity test conducted in order to find out the data instrument accuracy that filled out by the respondent. In this research, the instrument in each variable that will be conducted a validity test is the instrument in Understandability, Learnability, Operability, Attractiveness, and Usability Compliance variable.

Understandability variable has 9 instruments that will be conducted the validity test. The validity test result toward Understandability variable instrument could be seen in Table 4.23.

Table 4.23 Understandability Variable Instrument Validity Test Result

Instrument	r _{xy}	Significant	r _{tabel}	Category
UB01	0.753**	0.01	0.181	High Validity
UB02	0.721**	0.01	0.181	High Validity
UB03	0.766**	0.01	0.181	High Validity
UW01	0.771**	0.01	0.181	High Validity
UW02	0.746**	0.01	0.181	High Validity
UW03	0.760**	0.01	0.181	High Validity
UL01	0.747**	0.01	0.181	High Validity
UL02	0.764**	0.01	0.181	High Validity
UL03	0.751**	0.01	0.181	High Validity

Table 4.23 shows that r_{xy} value that form r_{hitung} has a higher value than r_{tabel} . The r_{tabel} value in each instrument obtained from r_{tabel} Product Moment distribution with 0.01 significant level and 204 respondent population measure (N). Based on coefficient validity category, all instruments in Understandability variable are valid with a high validity level. It is shows that all the instruments which measured are produce an accurate and credible data with minimum standard of 0.721 r_{xy} value and 99% confidence level.

Learnability variable has 6 instruments that will be conducted the validity test. The validity test result toward Learnability variable instrument could be seen in Table 4.24.

Table 4.24 Learnability Variable Instrument Validity Test Result

Instrument	r_{xy}	Significant	r_{tabel}	Category
LB01	0.764**	0.01	0.181	High Validity
LB02	0.766**	0.01	0.181	High Validity
LW01	0.777**	0.01	0.181	High Validity
LW02	0.795**	0.01	0.181	High Validity
LL01	0.731**	0.01	0.181	High Validity
LL02	0.777**	0.01	0.181	High Validity

Table 4.24 shows that r_{xy} value that form r_{hitung} has a higher value than r_{tabel} . The r_{tabel} value in each instrument obtained from r_{tabel} Product Moment distribution with 0.01 significant level and 204 respondent population measure (N). Based on coefficient validity category, all instruments in Learnability variable are valid with a high validity level. It is shows that all the instruments which measured are produce an accurate and credible data with minimum standard of 0.731 r_{xy} value and 99% confidence level.

Operability variable has 12 instruments that will be conducted the validity test. The validity test result toward Operability variable instrument could be seen in Table 4.25.

Table 4.25 Operability Variable Instrument Validity Test Result

Instrument	r_{xy}	Significant	r_{tabel}	Category
OB01	0.616**	0.01	0.181	High Validity
OB02	0.674**	0.01	0.181	High Validity
OB03	0.700**	0.01	0.181	High Validity
OB04	0.669**	0.01	0.181	High Validity
OW01	0.596**	0.01	0.181	Moderate Validity
OW02	0.662**	0.01	0.181	High Validity
OW03	0.696**	0.01	0.181	High Validity
OW04	0.709**	0.01	0.181	High Validity
OL01	0.739**	0.01	0.181	High Validity
OL02	0.716**	0.01	0.181	High Validity
OL03	0.692**	0.01	0.181	High Validity
OL04	0.648**	0.01	0.181	High Validity

Table 4.25 shows that r_{xy} value that form r_{hitung} has a higher value than r_{tabel} . The r_{tabel} value in each instrument obtained from r_{tabel} Product Moment distribution with 0.01 significant level and 204 respondent population measure (N). Based on coefficient validity category, all instruments in Operability variable are valid with each classification levels. The instrument that counted as a moderate validity is only OW01 instrument, while the instruments that counted as high validity are OB01, OB02, OB03, OB04, OW02, OW03, OW04, OL01, OL02, OL03, and OL04 instrument. It is shows that all the instruments which measured are produce an accurate and credible data with minimum standard of 0.596 r_{xy} value and 99% confidence level.

Attractiveness variable has 12 instruments that will be conducted the validity test. The validity test result toward Attractiveness variable instrument could be seen in Table 4.26.

Table 4.26 Attractiveness Variable Instrument Validity Test Result

Instrument	r_{xy}	Significant	r_{tabel}	Category
AB01	0.664**	0.01	0.181	High Validity
AB02	0.732**	0.01	0.181	High Validity
AB03	0.742**	0.01	0.181	High Validity
AB04	0.726**	0.01	0.181	High Validity
AW01	0.682**	0.01	0.181	High Validity
AW02	0.641**	0.01	0.181	High Validity
AW03	0.692**	0.01	0.181	High Validity
AW04	0.623**	0.01	0.181	High Validity
AL01	0.692**	0.01	0.181	High Validity
AL02	0.746**	0.01	0.181	High Validity
AL03	0.752**	0.01	0.181	High Validity
AL04	0.725**	0.01	0.181	High Validity

Table 4.26 shows that r_{xy} value that form r_{hitung} has a higher value than r_{tabel} . The r_{tabel} value in each instrument obtained from r_{tabel} Product Moment distribution with 0.01 significant level and 204 respondent population measure (N). Based on coefficient validity category, all instruments in Attractiveness variable are valid with a high validity level. It is shows that all the instruments which measured are produce an accurate and credible data with minimum standard of 0.623 r_{xy} value and 99% confidence level.

Usability Compliance variable has 18 instruments that will be conducted the validity test. The validity test result toward Usability Compliance variable instrument could be seen in Table 4.27.

Table 4.27 Usability Compliance Variable Instrument Validity Test Result

Instrument	r_{xy}	Significant	r_{tabel}	Category
UCB01	0.540**	0.01	0.181	Moderate Validity
UCB02	0.548**	0.01	0.181	Moderate Validity
UCB03	0.572**	0.01	0.181	Moderate Validity
UCB04	0.542**	0.01	0.181	Moderate Validity
UCB05	0.585**	0.01	0.181	Moderate Validity
UCB06	0.552**	0.01	0.181	Moderate Validity
UCW01	0.555**	0.01	0.181	Moderate Validity
UCW02	0.617**	0.01	0.181	High Validity
UCW03	0.606**	0.01	0.181	High Validity
UCW04	0.598**	0.01	0.181	Moderate Validity
UCW05	0.504**	0.01	0.181	Moderate Validity
UCW06	0.553**	0.01	0.181	Moderate Validity
UCL01	0.531**	0.01	0.181	Moderate Validity
UCL02	0.577**	0.01	0.181	Moderate Validity
UCL03	0.573**	0.01	0.181	Moderate Validity
UCL04	0.542**	0.01	0.181	Moderate Validity
UCL05	0.584**	0.01	0.181	Moderate Validity
UCL06	0.522**	0.01	0.181	Moderate Validity

Table 4.27 shows that r_{xy} value from r_{hitung} has a higher value than r_{tabel} . The r_{tabel} value in each instrument obtained from r_{tabel} Product Moment distribution with 0.01 significant level and 204 respondent population measure (N). Based on coefficient validity category, all instruments in Usability Compliance variable are valid with each classification levels. The instruments that counted as high validity are UCW02 and UCW03 instrument. While the instruments that counted as moderate validity are UCB01, UCB02, UCB03, UCB04, UCB05, UCB06, UCW01, UCW04, UCW05, UCW06, UCL01, UCL02, UCL03, UCL04, UCL05, and UCL06 instrument. It shows that all the instruments which measured are produce an accurate and credible data with minimum standard of 0.504 r_{xy} value and 99% confidence level.

4.2.3 Variable Reliability Testing

After the validity test conducted, reliability of each variable also being tested. This testing conducted to measuring the precision and consistency score for each instrument that filled out by respondent. The precision and consistency score will be found out from Cronbach-Alpha value which then converted to reliability coefficient category. Reliability testing result toward each variable could be seen in Table 4.28.

Table 4.28 Reliability Test Result for Each Variable

Variable	Cronbach Alpha (r_{11})	Total Instrument	Category
Understandability	0.779	9	High Reliability
Learnability	0.792	8	High Reliability
Operability	0.763	12	High Reliability
Attractiveness	0.766	12	High Reliability
Usability Compliance	0.708	18	High Reliability

Table 4.28 shows that r_{11} value which is Cronbach-Alpha reliability coefficient gives a reliable result with 204 respondents population measure (N). The result for each variable is on high reliability level. It is shows that all variables which measured are produces an accurate and credible data with minimum standard of 0.708 r_{11} value.

4.3 ISO 9126-1 Quality Model Characteristic Weighting Result

ISO 9126-1 Quality Model characteristic weight was needed to obtain analysis factor total value percentage from each characteristic. To find out the weight value, questionnaire distribution conducted to 30 respondents which fulfilled the conditions determined. Based on the questionnaire distribution

conducted, AHP pairwise comparison result for each ISO 9126-1 Quality Model characteristic could be seen in Table 4.29.

Table 4.29 ISO 9126-1 Characteristic Pairwise Comparison Result

No	First Element	Comparison		Second Element
		Scale	Definition	
1	Functionality	3	Abit More Important	Reliability
2	Functionality	1	Equally Important	Usability
		5	More Important	
3	Functionality	5	More Important	Efficiency
4	Functionality	9	Absolutely More Important	Maintainability
5	Functionality	1	Equally Important	Portability
		7	Extremely More Important	
6	Reliability	5	More Important	Usability
7	Reliability	1	Equally Important	Efficiency
8	Reliability	5	More Important	Maintainability
9	Reliability	7	Extremely More Important	Portability
10	Usability	1	Equally Important	Efficiency
		5	More Important	
11	Usability	5	More Important	Maintainability
12	Usability	1	Equally Important	Portability
13	Efficiency	5	More Important	Maintainability
14	Efficiency	1	Equally Important	Portability
15	Maintainability	1	Equally Important	Portability

Table 4.29 shows the pairwise comparison toward ISO 9126-1 Quality Model characteristic determined. In Functionality and Usability characteristic pairwise the 5 (More Important) scale is selected. In Functionality and Portability characteristic pairwise the 7 (Extremely Important) scale is selected. While in Usability and Efficiency characteristic pairwise the 1 (Equally Important) scale is selected. It is happen due to the pairwise comparison produce a suitably Consistency Ratio (CR) value compared with another scale. ISO 9126-1 Quality Model characteristic weighting process is using BPMSG AHP Priority Calculator tools and could be seen in Figure 4.1.



Figure 4.1 ISO 9126-1 Quality Model Characteristic Weight Comparison Process

Consistency Ratio (CR) showed in Figure 4.1 has 9.1% valued for ISO 9126-1 Quality Model characteristic. It is indicate that a pairwise comparison which filled out by the respondent is rated consistency, so that the weight order result obtain could be trusted. ISO 9126-1 Quality Model characteristic priority weight order and decision matrix result is could be seen in Figure 4.2.

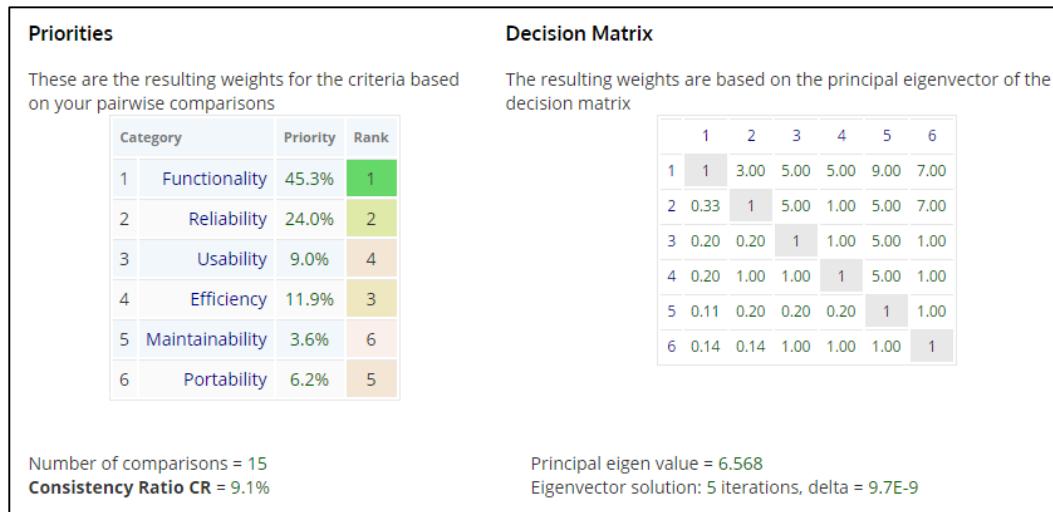


Figure 4.2 ISO 9126-1 Characteristic Weight Order and Matrix Result

Figure 4.2 shows that the weight priority produce characteristics order from the highest to the lowest weight. ISO 9126-1 Quality Model characteristic priority order obtain begin with Functionality, Reliability, Efficiency, Usability, Portability, and ended with Maintainability.

4.4 ISO 9126-1 Quality Model Subcharacteristic Weighting Result

ISO 9126-1 Quality Model subcharacteristic weight was needed to obtain subcharacteristic total value percentage from each characteristic. To find out the weight value, questionnaire distribution conducted to 30 respondents which fulfilled the conditions determined. The subcharacteristics weights determine are the subcharacteristics in each Functionality, Efficiency, Usability, Portability, Reliability, and Maintainability characteristics.

4.4.1 Functionality's Subcharacteristic Weight

There are five subcharacteristics weight determined in Functionality characteristic, they are Suitability, Accuracy, Security, Interoperability, and Functionality Compliance. Based on the questionnaire distribution conducted, AHP pairwise comparison result for each Functionality's subcharacteristic could be seen in Table 4.30.

Table 4.30 Functionality's Subcharacteristic Comparison Result

No	First Element	Comparison		Second Element
		Scale	Definition	
1	Suitability	1	Equally Important	Accuracy
2	Suitability	1	Equally Important	Security
		7	Extremely More Important	
3	Suitability	2	Between Equally Important and Abit More Important	Interoperability
4	Suitability	1	Equally Important	F. Compliance
5	Accuracy	1	Equally Important	Security
6	Accuracy	5	More Important	Interoperability
7	Accuracy	1	Equally Important	F. Compliance
8	Security	5	More Important	Interoperability
9	Security	1	Equally Important	F. Compliance
10	Interoperability	1	Equally Important	F. Compliance

Table 4.30 shows the pairwise comparison toward Functionality's subcharacteristic determined. In Suitability and Security subcharacteristic pairwise the 1 (Equally Important) scale is selected. It is happen due to the pairwise comparison produce a suitably Consistency Ratio (CR) value compared with another scale. Functionality's subcharacteristic weighting process is using BPMSG AHP Priority Calculator tools and could be seen in Figure 4.3.

A - Importance - or B?		Equal	How much more?									
1	<input checked="" type="radio"/> Suitability or <input type="radio"/> Accuracy	1	<input checked="" type="radio"/>	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8	<input type="radio"/> 9	
2	<input checked="" type="radio"/> Suitability or <input type="radio"/> Security	1	<input checked="" type="radio"/>	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8	<input type="radio"/> 9	
3	<input checked="" type="radio"/> Suitability or <input type="radio"/> Interoperability	1	<input checked="" type="radio"/>	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8	<input type="radio"/> 9	
4	<input checked="" type="radio"/> Suitability or <input type="radio"/> Functionality Compliance	1	<input checked="" type="radio"/>	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8	<input type="radio"/> 9	
5	<input type="radio"/> Accuracy or <input checked="" type="radio"/> Security	1	<input checked="" type="radio"/>	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8	<input type="radio"/> 9	
6	<input type="radio"/> Accuracy or <input checked="" type="radio"/> Interoperability	1	<input checked="" type="radio"/>	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input checked="" type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8	<input type="radio"/> 9	
7	<input type="radio"/> Accuracy or <input checked="" type="radio"/> Functionality Compliance	1	<input checked="" type="radio"/>	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8	<input type="radio"/> 9	
8	<input type="radio"/> Security or <input checked="" type="radio"/> Interoperability	1	<input checked="" type="radio"/>	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input checked="" type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8	<input type="radio"/> 9	
9	<input type="radio"/> Security or <input checked="" type="radio"/> Functionality Compliance	1	<input checked="" type="radio"/>	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8	<input type="radio"/> 9	
10	<input checked="" type="radio"/> Interoperability or <input type="radio"/> Functionality Compliance	1	<input checked="" type="radio"/>	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8	<input type="radio"/> 9	
CR = 6.9% OK												
<input style="width: 150px; height: 25px; border: 1px solid black; padding: 2px 10px; font-size: 10px; font-weight: bold; color: black; background-color: white; cursor: pointer;" type="button" value="Calculate Result"/>		<input checked="" type="radio"/> AHP	<input type="radio"/> Balanced scale	<input style="width: 150px; height: 25px; border: 1px solid black; padding: 2px 10px; font-size: 10px; font-weight: bold; color: black; background-color: white; cursor: pointer;" type="button" value="Download (.csv)"/>								
<input type="checkbox"/> dec. comma												

Figure 4.3 Functionality's Subcharacteristic Weigh Comparison Process

Consistency Ratio (CR) showed in Figure 4.3 has 6.9% valued for Functionality's subcharacteristic. It is indicates that a pairwise comparison which filled out by the respondent is consistence, so that the weight order result obtain could be trusted. Functionality's subcharacteristic priority weight order and decision matrix result is could be seen in Figure 4.4.

Priorities			Decision Matrix																																																			
These are the resulting weights for the criteria based on your pairwise comparisons			The resulting weights are based on the principal eigenvector of the decision matrix																																																			
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Category</th><th style="text-align: center;">Priority</th><th style="text-align: center;">Rank</th></tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td><td style="text-align: center;">Suitability</td><td style="text-align: center;">20.6%</td></tr> <tr> <td style="text-align: center;">2</td><td style="text-align: center;">Accuracy</td><td style="text-align: center;">25.7%</td></tr> <tr> <td style="text-align: center;">3</td><td style="text-align: center;">Security</td><td style="text-align: center;">25.7%</td></tr> <tr> <td style="text-align: center;">4</td><td style="text-align: center;">Interoperability</td><td style="text-align: center;">9.1%</td></tr> <tr> <td style="text-align: center;">5</td><td style="text-align: center;">Functionality Compliance</td><td style="text-align: center;">18.8%</td></tr> </tbody> </table>			Category	Priority	Rank	1	Suitability	20.6%	2	Accuracy	25.7%	3	Security	25.7%	4	Interoperability	9.1%	5	Functionality Compliance	18.8%	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">1</th><th style="text-align: center;">2</th><th style="text-align: center;">3</th><th style="text-align: center;">4</th><th style="text-align: center;">5</th></tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td><td style="text-align: center;">1.00</td><td style="text-align: center;">1.00</td><td style="text-align: center;">2.00</td><td style="text-align: center;">1.00</td></tr> <tr> <td style="text-align: center;">2</td><td style="text-align: center;">1.00</td><td style="text-align: center;">1</td><td style="text-align: center;">1.00</td><td style="text-align: center;">5.00</td></tr> <tr> <td style="text-align: center;">3</td><td style="text-align: center;">1.00</td><td style="text-align: center;">1.00</td><td style="text-align: center;">1</td><td style="text-align: center;">5.00</td></tr> <tr> <td style="text-align: center;">4</td><td style="text-align: center;">0.50</td><td style="text-align: center;">0.20</td><td style="text-align: center;">0.20</td><td style="text-align: center;">1</td></tr> <tr> <td style="text-align: center;">5</td><td style="text-align: center;">1.00</td><td style="text-align: center;">1.00</td><td style="text-align: center;">1.00</td><td style="text-align: center;">1</td></tr> </tbody> </table>				1	2	3	4	5	1	1.00	1.00	2.00	1.00	2	1.00	1	1.00	5.00	3	1.00	1.00	1	5.00	4	0.50	0.20	0.20	1	5	1.00	1.00	1.00	1
Category	Priority	Rank																																																				
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1	1.00	1.00	2.00	1.00																																																		
2	1.00	1	1.00	5.00																																																		
3	1.00	1.00	1	5.00																																																		
4	0.50	0.20	0.20	1																																																		
5	1.00	1.00	1.00	1																																																		
Number of comparisons = 10 Consistency Ratio CR = 6.9%			Principal eigen value = 5.309 Eigenvector solution: 6 iterations, delta = 8.0E-9																																																			

Figure 4.4 Functionality's Subcharacteristic Weight Order Result

Figure 4.4 shows that the weight priority produce subcharacteristics order from the highest to the lowest weight. Functionality's subcharacteristic priority order obtain begin with Security, Accuracy, Suitability, Functionality Compliance, and ended with Interoperability.

4.4.2 Reliability's Subcharacteristic Weight

There are four subcharacteristics weight determined in Reliability characteristic, they are Maturity, Fault Tolerance, Recoverability, and Reliability Compliance. Based on the questionnaire distribution conducted, AHP pairwise comparison result for each Reliability's subcharacteristic could be seen in Table 4.31.

Table 4.31 Reliability's Subcharacteristic Comparison Result

No	First Element	Comparison		Second Element
		Scale	Definition	
1	Maturity	1	Equally Important	Fault Tolerance
2	Maturity	2	Between Equally Important and Abit More Important	Recoverability
3	Maturity	1	Equally Important	R. Compliance
4	Fault Tolerance	2	Between Equally Important and Abit More Important	Recoverability
5	Fault Tolerance	1	Equally Important	R. Compliance
6	Recoverability	1	Equally Important	R. Compliance

Table 4.31 shows the pairwise comparison toward Reliability's subcharacteristic determined. Reliability's subcharacteristic weighting process is using BPMSG AHP Priority Calculator tools and could be seen in Figure 4.5.

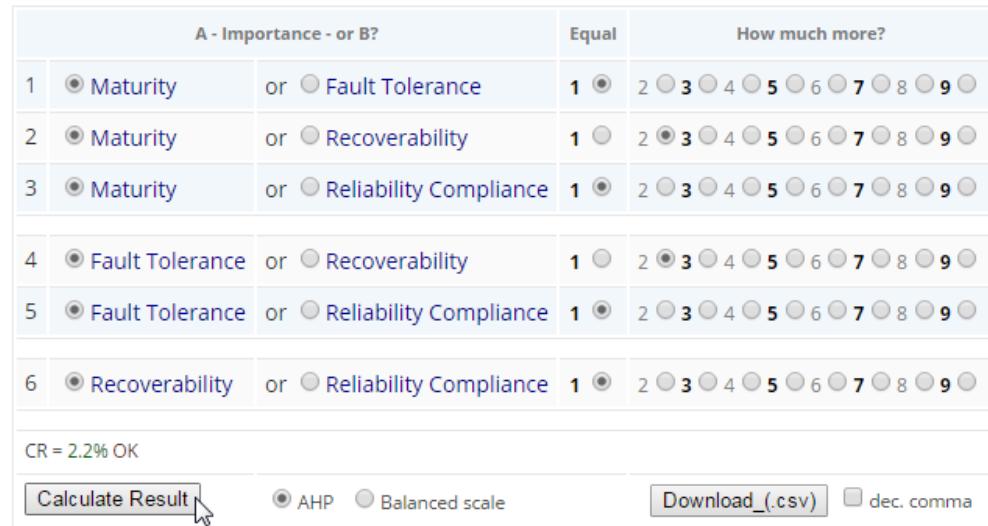


Figure 4.5 Reliability's Subcharacteristic Weight Comparison Process

Consistency Ratio (CR) showed in Figure 4.5 has 2.2% valued for Reliability's subcharacteristic. It indicates that a pairwise comparison which filled out by the respondent has a good consistency, so that the weight order result obtain could be trusted. Reliability' subcharacteristic priority weight order and decision matrix result is could be seen in Figure 4.6.

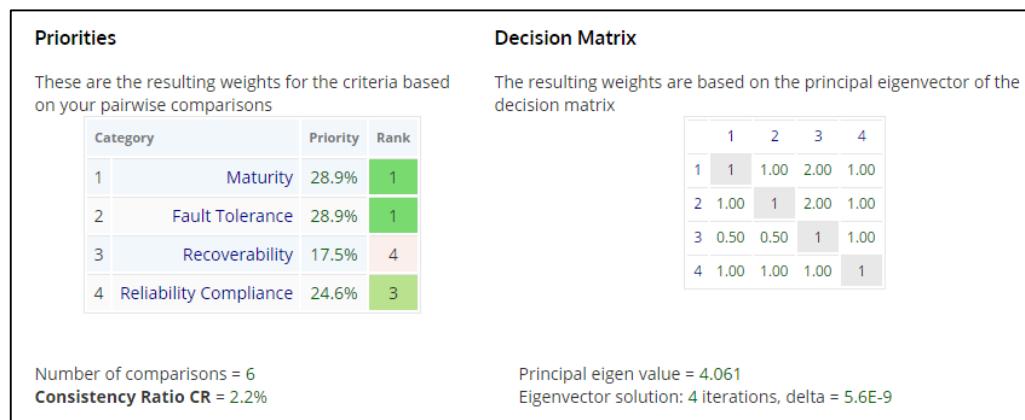


Figure 4.6 Reliability's Subcharacteristic Weight Order Result

Figure 4.6 shows that the weight priority produce subcharacteristics order from the highest to the lowest weight. Reliability's subcharacteristic priority order

obatain began with Maturity, Fault Tolerance, Reliability Compliance, and ended with Recoverability.

4.4.3 Efficiency's Subcharacteristic Weight

There are three subcharacteristics weight determined in Efficiency characteristic, they are Time Behaviour, Resource Utilization, dan Efficiency Compliance. Based on the questionnaire distribution conducted, AHP pairwise comparison result for each Efficiency's subcharacteristic could be seen in Table 4.32.

Table 4.32 Efficiency's Subcharacteristic Comparison Result

No	First Element	Comparison		Second Element
		Scale	Definition	
1	Time Behaviour	1	Equally Important	Resource Utilization
2	Time Behaviour	1	Equally Important	E. Compliance
3	Resource Utilization	1	Equally Important	E. Compliance

Table 4.32 shows the pairwise comparison toward Efficiency's subcharacteristic determined. Efficiency's subcharacteristic weighting process is using BPMMSG AHP Priority Calculator tools and could be seen in Figure 4.7.

A - Importance - or B?		Equal	How much more?										
1	<input checked="" type="radio"/> Time Behaviour or <input type="radio"/> Resource Utilization	1	<input checked="" type="radio"/>	2	<input type="radio"/>								
2	<input checked="" type="radio"/> Time Behaviour or <input type="radio"/> Efficiency Compliance	1	<input checked="" type="radio"/>	2	<input type="radio"/>								
3	<input checked="" type="radio"/> Resource Utilization or <input type="radio"/> Efficiency Compliance	1	<input checked="" type="radio"/>	2	<input type="radio"/>								
CR = 0% OK													
<input type="button" value="Calculate Result"/>		<input checked="" type="radio"/> AHP	<input type="radio"/> Balanced scale	<input type="button" value="Download (.csv)"/>									<input type="checkbox"/> dec. comma

Figure 4.7 Efficiency's Subcharacteristic Weight Comparison Process

Consistency Ratio (CR) showed in Figure 4.7 has 0% valued which is a perfect percentage for pairwise comparison in Efficiency's subcharacteristic. It indicates that a pairwise comparison which filled out by the respondent is very consistence, so that the weight order result obtain could be trusted. Efficiency' subcharacteristic priority weight order and decision matrix result is could be seen in Figure 4.8.

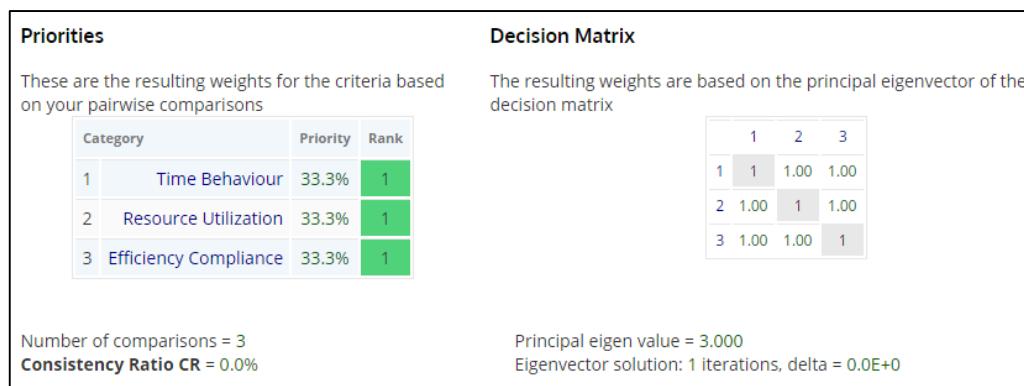


Figure 4.8 Efficiency's Subcharacteristic Weight Order Result

Figure 4.8 shows that the weight priority produces balance subcharacteristics. All subcharacteristic obtain 33.3% weight priority percentage. It indicates that Time Behavior, Resource Utilization, and Efficiency Compliance are interrelated.

4.4.4 Usability's Subcharacteristic Weight

There are five subcharacteristics weight determined in Usability characteristic, they are Understandability, Learnability, Operability, Attractiveness, and Usability Compliance. Based on the questionnaire distribution conducted, AHP pairwise comparison result for each Usability's subcharacteristic could be seen in Table 4.33.

Table 4.33 Usability's Subcharacteristic Comparison Result

No	First Element	Comparison		Second Element
		Scale	Definition	
1	Understandability	1	Equally Important	Learnability
2	Understandability	1	Equally Important	Operability
3	Understandability	1	Equally Important	Attractiveness
4	Understandability	1	Equally Important	U. Compliance
5	Learnability	1	Equally Important	Operability
6	Learnability	2	Between Equally Important and Abit More Important	Attractiveness
7	Learnability	1	Equally Important	U. Compliance
8	Operability	3	Abit More Important	Attractiveness
9	Operability	3	Abit More Important	U. Compliance
10	Attractiveness	3	Abit More Important	U. Compliance

Table 4.33 shows the pairwise comparison toward Usability's subcharacteristic determined. Usability's subcharacteristic weighting process is using BPMSG AHP Priority Calculator tools and could be seen in Figure 4.9.

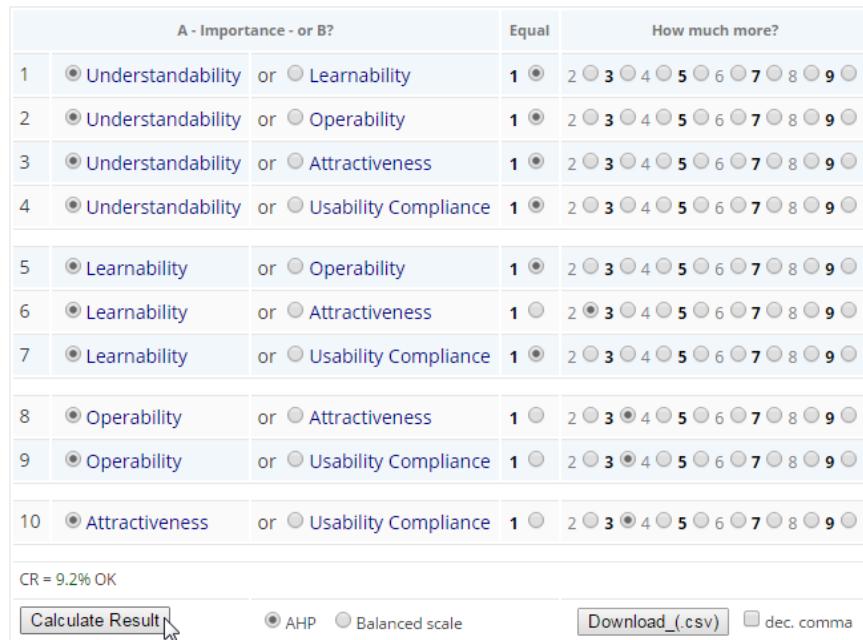


Figure 4.9 Usability's Subcharacteristic Weight Comparison Process

Consistency Ratio (CR) showed in Figure 4.9 has 9.2% valued for Usability's subcharacteristic. It indicates that a pairwise comparison which filled out by the

respondent is rated consistency, so that the weight order result obtain could be trusted. Usability's subcharacteristic priority weight order and decision matrix result is could be seen in Figure 4.10.

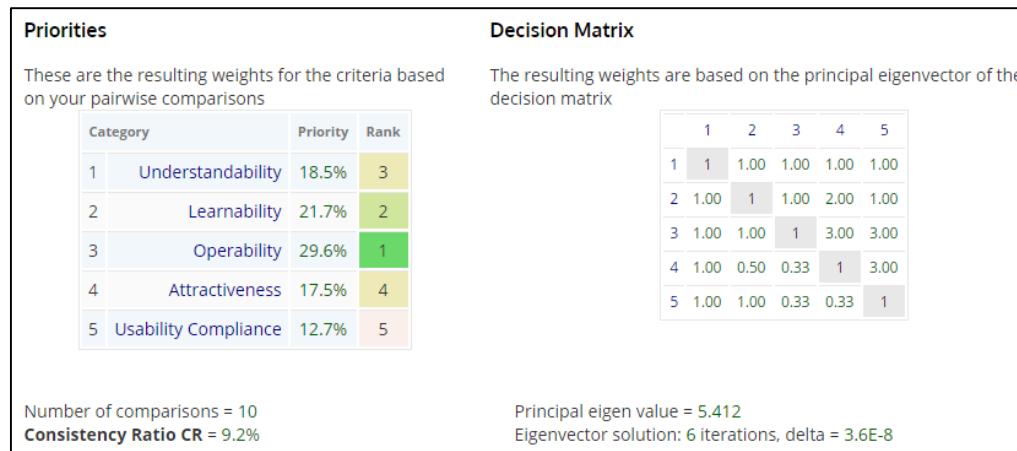


Figure 4.10 Usability's Subcharacteristic Weight Order Result

Figure 4.10 shows that the weight priority produce subcharacteristics order from the highest to the lowest weight. Usability's subcharacteristic priority order obtain begin with Operability, Learnability, Understandability, Attractiveness, and ended with Usability Compliance.

4.4.5 Portability's Subcharacteristic Weight

There are five subcharacteristics weight determined in Portability characteristic, they are Adaptability, Installability, Coexistence, Replaceability, and Portability Compliance. Based on the questionnaire distribution conducted, AHP pairwise comparison result for each Portability's subcharacteristic could be seen in Table 4.34.

Table 4.34 Portability's Subcharacteristic Comparison Result

No	First Element	Comparison		Second Element
		Scale	Definition	
1	Adaptability	1	Equally Important	Installability
2	Adaptability	2	Between Equally Important and Abit More Important	Coexistence
3	Adaptability	2	Between Equally Important and Abit More Important	Replaceability
4	Adaptability	1	Equally Important	P. Compliance
5	Installability	7	Extremely More Important	Coexistence
6	Installability	2	Between Equally Important and Abit More Important	Replaceability
		9	Absolutely More Important	
7	Installability	1	Equally Important	P. Compliance
8	Coexistence	1	Equally Important	Replaceability
9	Coexistence	1	Equally Important	P. Compliance
10	Replaceability	1	Equally Important	P. Compliance

Table 4.34 shows the pairwise comparison toward Portability's subcharacteristic determined. In Installability and Replaceability subcharacteristic pairwise the 2 (Between Equally Important and Abit More Important) scale is selected. It is happen due to the pairwise comparison produce a suitably Consistency Ratio (CR) value compared with another scale. Portability's subcharacteristic weighting process is using BPMSG AHP Priority Calculator tools and could be seen in Figure 4.11.



Figure 4.11 Portability's Subcharacteristic Weight Comparison Process

Consistency Ratio (CR) showed in Figure 4.11 has 7.9% valued for Portability's subcharacteristic. It is indicates that a pairwise comparison which filled out by the respondent is consistence, so that the weight order result obtain could be trusted. Portability's subcharacteristic priority weight order and decision matrix result is could be seen in Figure 4.12.

Priorities			Decision Matrix																																																				
These are the resulting weights for the criteria based on your pairwise comparisons			The resulting weights are based on the principal eigenvector of the decision matrix																																																				
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Category</th> <th>Priority</th> <th>Rank</th> </tr> </thead> <tbody> <tr> <td>1 Adaptability</td> <td>23.2%</td> <td>2</td> </tr> <tr> <td>2 Installability</td> <td>33.6%</td> <td>1</td> </tr> <tr> <td>3 Coexistence</td> <td>11.1%</td> <td>5</td> </tr> <tr> <td>4 Replaceability</td> <td>13.4%</td> <td>4</td> </tr> <tr> <td>5 Portability Compliance</td> <td>18.7%</td> <td>3</td> </tr> </tbody> </table>			Category	Priority	Rank	1 Adaptability	23.2%	2	2 Installability	33.6%	1	3 Coexistence	11.1%	5	4 Replaceability	13.4%	4	5 Portability Compliance	18.7%	3	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> </tr> </thead> <tbody> <tr> <td>1 1.00</td> <td>2.00</td> <td>2.00</td> <td>1.00</td> <td></td> </tr> <tr> <td>2 1.00</td> <td>1 7.00</td> <td>2.00</td> <td>1.00</td> <td></td> </tr> <tr> <td>3 0.50</td> <td>0.14</td> <td>1 1.00</td> <td>1.00</td> <td></td> </tr> <tr> <td>4 0.50</td> <td>0.50</td> <td>1.00</td> <td>1 1.00</td> <td></td> </tr> <tr> <td>5 1.00</td> <td>1.00</td> <td>1.00</td> <td>1.00</td> <td>1</td> </tr> </tbody> </table>					1	2	3	4	5	1 1.00	2.00	2.00	1.00		2 1.00	1 7.00	2.00	1.00		3 0.50	0.14	1 1.00	1.00		4 0.50	0.50	1.00	1 1.00		5 1.00	1.00	1.00	1.00	1
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Number of comparisons = 10 Consistency Ratio CR = 7.9%			Principal eigen value = 5.357 Eigenvector solution: 6 iterations, delta = 6.7E-9																																																				

Figure 4.12 Portability's Subcharacteristic Weight Order Result

Figure 4.12 shows that the weight priority produce subcharacteristics order from the highest to the lowest weight. Portability's subcharacteristic priority order obtain begin with Installability, Adaptability, Portability Compliance, Replaceability, and ended with Coexistence.

4.4.6 Maintainability Subcharacteristic Weight

There are two subcharacteristics weight determined in Maintainability characteristic they are Analyzability dan Maintainability Compliance. Based on the questionnaire distribution conducted, AHP pairwise comparison result for each Maintainability's subcharacteristic could be seen in Table 4.35.

Table 4.35 Maintainability's Subcharacteristic Comparison Result

No	First Element	Comparison		Second Element
		Scale	Definition	
1	Analyzability	1	Equally Important	M. Compliance

Table 4.35 shows the pairwise comparison toward Maintainability's subcharacteristic determined. Maintainability's subcharacteristic weighting process is using BPMSG AHP Priority Calculator tools and could be seen in Figure 4.13.

The screenshot shows a pairwise comparison dialog. At the top, it asks "A - Importance - or B?". Below that, there are two radio buttons: one selected for "Analyzeability" and one for "Maintainability Compliance". To the right of the radio buttons are scales from 1 to 9, with "1" being "Equal" and "9" being "How much more?". Below the scales, the text "CR = 0% OK" is displayed in green. At the bottom left is a "Calculate Result" button with a cursor pointing at it. Next to it are two radio buttons: "AHP" (selected) and "Balanced scale". To the right are two checkboxes: "Download (.csv)" and "dec. comma".

Figure 4.13 Maintainability's Subcharacteristic Weight Comparison Process

Consistency Ratio (CR) showed in Figure 4.13 has 0% valued which is a perfect percentage for pairwise comparison in Maintainability's subcharacteristic. It indicates that a pairwise comparison which filled out by the respondent is very consistence, so that the weight order result obtain could be trusted. Maintainability' subcharacteristic priority weight order and decision matrix result is could be seen in Figure 4.14.

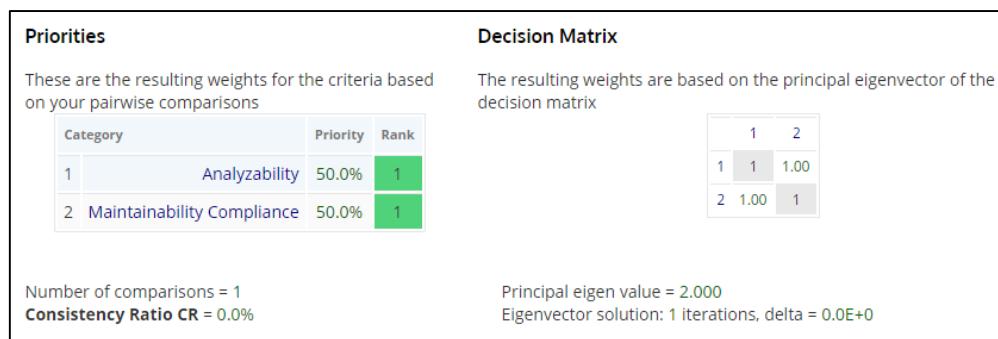


Figure 4.14 Maintainability's Subcharacteristic Weight Order Result

Figure 4.14 shows that the weight priority produces balance subcharacteristics between Analyzability and Maintainability Compliance. Both of those subcharacteristics obtain 50% weight priority percentage. It indicates that Analyzability and Maintainability Compliance subcharacteristic are interrelated.

4.5 Testing of BlackBerry Messenger (BBM) Application

BlackBerry Messenger (BBM) is an instant messenger application developed by BlackBerry Limited, formerly known as Research In Motion Limited (RIM). Instant messenger application ranked first version of Nielsen's most widely used to test the quality based on standard ISO 9126-1 Quality Model. Tests performed on

the application of BlackBerry Messenger (BBM) Android-based smartphone size <5 inch with the latest version, which is version 2.8.0.21.

4.5.1 Testing of Functionality Characteristics

Quality of BlackBerry Messenger (BBM) application Android based tested on the Functionality characteristic consists of five subcharacteristic to be assessed. Fifth subcharacteristic include Security, Accuracy, Suitability, Functionality Compliance, and Interoperability. Functionality characteristics tests against each subcharacteristic are as follows:

1. Security

BlackBerry Messenger (BBM) applications testing on Security subcharacteristic tested using Blackbox Testing. The test is performed by observing the security, confidentiality of messages, and unauthorized access of the application. Results of testing the quality of Security subcharacteristic can be seen in Table 4.36.

Table 4.36 BBM Testing Results on Security Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Security Functions a. Sign Up	Sign Up process will be successful if it meets the safety requirements where: 1. Name, Email, and Password required 2. Email must contain @ symbol and correct domain name	Sign Up process is successfully carried out in compliance with the safety requirements where: 1. Name, Email, and Password have been filled 2. Email has contain @ and domain, even though the domain is entered	Success Failed

No.	Test Case	Expected Results	Actual Results	Status
		3. Passwords must have a length of characters between 6-20 with one capital letter (A-Z), lowercase letters (a-z), numbers (0-9), as well as punctuation (^ _ # * +?! =. { } ~ `&)	instead of the correct domain. 3. Passwords have a length of characters between 6-20 with one uppercase, lowercase, numbers, and punctuation	Success
	b. Sign In System	If Sign In process fails, the message dialog will appear to inform that the username and password entered is not valid with BlackBerry ID	Sign In fails if username and password entered is not valid with BlackBerry ID	Success
	c. Reset Password System	Reset password will be processed and sent via email if the user enter a verification code (captcha) and answer the questions correctly	Reset password successfully processed and sent via email after users enter a verification code (captcha) and answer the questions correctly	Success
	d. Invite System	a. Invite will be sent to the user after QR Code is scanned by other users b. Invite will be sent to other users intended if QR Code is scanned or entered PIN can be read	a. Invite successfully sent to the user after QR Code is scanned by other users b. Invite successfully delivered to the other users after scan QR code or enter a PIN belonging to other users correctly	Success
	e. BBM Settings System	User privacy settings can be set as the user desires, such as: 1. Show my country and time	User privacy settings successfully set as the user desires, such as: 1. Show my country and time	Success

No.	Test Case	Expected Results	Actual Results	Status
	f. Chats Settings System	<p>2. Show what I'm listening to</p> <p>3. Show what others are listening to</p> <p>4. Find friends already using BBM</p> <p>5. Allow BBM Calls Over Mobile Networks</p>	<p>2. Show what I'm listening to</p> <p>3. Show what others are listening to</p> <p>4. Find friends already using BBM</p> <p>5. Allow BBM Calls Over Mobile Networks</p>	
	g. Notifications Settings System	<p>Chat settings can be set as the user desires, such as:</p> <ol style="list-style-type: none"> 1. Show Display Pictures in Chats 2. Save and Delete Chat History 3. Show Action Bar with Keyboard 4. Always Show Keyboard 5. Always Accept HD Picture Requests 6. Time Messages 	<p>Chat settings successfully set as the user desires, such as:</p> <ol style="list-style-type: none"> 1. Show Display Pictures in Chats 2. Save and Delete Chat History 3. Show Action Bar with Keyboard 4. Always Show Keyboard 5. Always Accept HD Picture Requests 6. Time Messages 	Success
	h. Group Settings System	<p>Notification settings can be set as the user desires, such as:</p> <ol style="list-style-type: none"> 1. BBM Connected Icon 2. All Notifications 3. Vibrate and Vibrate on Ping 4. Tone BBM 5. LED Color 	<p>Notification settings successfully set as the user desires, such as:</p> <ol style="list-style-type: none"> 1. BBM Connected Icon 2. All Notifications 3. Vibrate and Vibrate on Ping 4. Tone BBM 5. LED Color 	Success
		<p>Group settings can be set as the user desires, such as:</p> <ol style="list-style-type: none"> 1. Chat notifications for this group 2. Picture notifications for this group 3. Allow members to invite others (if you are an administrator) 4. Edit administrators 	<p>Group settings successfully set as the user desires, such as:</p> <ol style="list-style-type: none"> 1. Chat notifications for this group 2. Picture notifications for this group 3. Allow members to invite others (if you are an administrator) 4. Edit administrators 	Success

No.	Test Case	Expected Results	Actual Results	Status
	i. Channel Settings System	5. Create administrator password Channel settings can be set as the user desires, such as: 1. Allow BBM Chats with you 2. Chat hours 3. Allow comments on posts 4. Approve comments 5. Show channel in search 6. Show channel activity in feeds	5. Create administrator password Channel setting successfully set as the user desires, such as: 1. Allow BBM Chats with you 2. Chat hours 3. Allow comments on posts 4. Approve comments 5. Show channel in search 6. Show channel activity in feeds	Success
	j. Contacts Settings System	Contacts settings can be set as the user desires, such as: 1. Contacts Layout 2. Security Question on Invites 3. Blocked Contacts and Feeds 4. Location (allow this app to access your device's current or saved locations)	Contact settings successfully set as the user desires, such as: 1. Contacts Layout 2. Security Question on Invites 3. Blocked Contacts and Feeds 4. Location (allow this app to access your device's current or saved locations)	Success
2	Virus Detection			
	a. Security Scanner via TrustGo Application	BlackBerry Messenger (BBM) Applications is safe after the scan process	BlackBerry Messenger (BBM) Applications declared safe after the scan process	Success
	b. Heartbleed Detector	Heartbleed undetectable virus that can steal information, although it is encrypted	BlackBerry Messenger (BBM) Applications successfully undetectable virus Heartbleed	Success

Table 4.36 shows that 14 test case successful and one which failed on 15 test cases were tested. From the results of test case, it is known that the

testing of quality of Security subcharacteristic gain value with a score of 4. This is because 93% of the security system on BlackBerry Messenger (BBM) applications has been available and running properly.

In addition, BlackBerry Messenger (BBM) application has 3 encryption process that hackers cannot know the content of message sent by the user. The encryption process occurs on BIS (BlackBerry Internet Service) and BES (BlackBerry Enterprise Server) package. At BIS package, BlackBerry Messenger (BBM) declared safe because messages sent via this application has been encrypted during the process of sending data to the carrier or provider BIS used by handheld BlackBerry. While the package of BES, AES encryption algorithm and 3-DES is used to master key of the enterprise. Not only that, the 3DES algorithm is also used in the PIN sender and PIN user. With the algorithm, the message sent through the BES server data will not be solved. [21]

2. Accuracy

Testing of BlackBerry Messenger (BBM) applications on Accuracy subcharacteristic tested using Blackbox Testing. The test is performed by observing the output results precision obtained from user input on the application. Results of testing quality of Accuracy subcharacteristic can be seen in Table 4.37.

Table 4.37 BBM Testing Results on Accuracy Aspects

No.	Test Case	Expected Results	Actual Results	Status
1	Forgot Password Reset Password System	At the time of Reset Password, password reset link will be emailed to the user	Password reset link successfully delivered to the user if the registered domain-related email	Success
2	Chatting			
	a. Send message	The message will be sent to the recipient when the message contains: 1. Lowercase characters (a-z) 2. Uppercase characters (A-Z) 3. Number (0-9) 4. Punctuation (~ `! @ # \$% ^ & * _ - + = { } [] \ ; : " , . <> / ?)	Message successfully delivered to the recipient when the message contains: 1. Lowercase characters (a-z) 2. Uppercase characters (A-Z) 3. Number (0-9) and became the link if a minimum number entered is 7 digits 4. Punctuation (~ `! @ # \$% ^ & * _ - + = { } [] \ ; : " , . <> / ?)	Success
	b. Send a message to 'Timed Message' feature	The message recipient can read the message sent to him within the period specified by the sender of the message	Recipient successfully reads the message in the timeframe specified by sender of the message	Success
	c. Attach Location	Location coordinates sent to the message recipient will be in accordance with the position of the sender	Location coordinates successfully delivered to the recipient in accordance with the position of the sender	Success
	d. Send Glympe	The location of the sender on the map will be followed during the timeframe specified by the sender	The location of the sender on the map successfully followed during the predetermined time span	Success
	e. Email Chat Systems	1. Chat is sent to the registered	1. Chat is sent to the registered email	Success

No.	Test Case	Expected Results	Actual Results	Status
	f. Notifications Chat	<p>email will be received by the owner of the email</p> <p>2. Chat is sent to the unlisted email will not be accepted by the owner of the email with the notification</p> <p>1. Chat that is being sent will be marked with icon))</p> <p>2. Chat that have been sent are marked with icon ✓</p> <p>3. Chat that have been accepted by the recipient of the message will be marked with the icon D which means Delivered</p> <p>4. Chat that have been read by the recipient of the message will be marked with icon R which means Read</p> <p>5. Chat that is being written by the sender of the message will be marked with the notice "is writing a message ..."</p>	<p>successfully received by the owner of the destination email</p> <p>2. Chat is sent to the unlisted email failed to be accepted by the owner destination email with notification</p> <p>1. Chat that is being sent successfully demonstrated icon))</p> <p>2. Chat that have been sent successfully demonstrated icon ✓</p> <p>3. Chat that have been accepted by the recipient of the message shows the icon D</p> <p>4. Chat that have been read by the recipient of the message shows the icon R</p> <p>5. Chat that is being written by the sender of the message successfully demonstrated notification "is writing a message ..."</p>	Success
3	Groups			
	Chat History	Chat history in Groups will be lost in accordance with a predetermined period	Chat history in Groups successfully lost in accordance with a predetermined period	Success
4	Contacts			
	a. Contacts	1. BBM contacts are sent to the	1. BBM contacts are sent to the	Success

No.	Test Case	Expected Results	Actual Results	Status
		registered email will be received by the owner of the email 2. BBM contacts sent via SMS will be received by the recipient	registered email successfully received by the owner of the destination email 2. BBM contacts that are sent via SMS successfully received by the recipient	Success
	b. Barcode Scan	QR Code is scanned will be directly read and added or delivered to the addressee	QR Code is scanned successfully read and added or delivered to the addressee	Success
	c. PIN BBM	PIN entered by the user will appear if the PIN is contained in the BBM database	PIN entered by the user successfully appear if the PIN is contained in the BBM database	Success
	d. Search	When a search is done and the data is available, it appears: 1. The message recipients contacts in BBM Contacts 2. Channels Name 3. Contacts in the BBM Invites	When a search is done and the data is available, then the search is successful showing: 1. The message recipients contacts in BBM Contacts 2. Channels Name 3. Contacts in the BBM Invites	Success

Table 4.37 shows that 18 test cases were tested successfully deliver the right and corresponding output results. From the results of test case, it is known that the quality testing of Accuracy subcharacteristic scored with a score of 5. It's indicates that BlackBerry Messenger (BBM) application has had the accurate output result and run very well.

3. Suitability

Testing of BlackBerry Messenger (BBM) applications on Suitability subcharacteristic tested using Blackbox Testing. The test is performed by observing the results of each function conformity between the expected results with the results given significantly. Results of quality testing of Suitability subcharacteristic can be seen in Table 4.38.

Table 4.38 BBM Testing Results on Suitability Aspects

No.	Test Case	Expected Results	Actual Results	Status
1	Sign Up			
	a. Press the 'Create Account' by entering the email address and password appropriate	Account will be created and appear the main page, namely BBM Chatting	Users successfully create an account and sign in to the main page	Success
	b. Press the 'Create Account' by entering an email address that does not match	No account has been successfully created and informed that the entered email address is incorrect	Users successfully create an account even though the email address is not appropriate or unlisted in the absence of confirmation via email that has been entered	Failed
	c. Press the 'Create Account' with a password that does not match	No account has been successfully created and informed that the password is entered yet qualified	Users do not succeed to create an account and must re-enter the password in accordance with the applicable requirements	Success
	d. Press the 'Sign Up'	Go to the page of Sign Up	Users successfully entered into the page of Sign Up	Success
2	Sign In			
	a. Press the 'Sign In' by entering the email address and	Sign In process successfully and appear contact page	User successfully Sign In and enter the contact page	Success

No.	Test Case	Expected Results	Actual Results	Status
	<p>a. Enter the email address or password is appropriate</p> <p>b. Press the 'Sign In' by entering the email address or password does not match</p> <p>c. Press the 'Forgot Password'</p>	<p>Sign In failed and alert the user to fill in data back</p> <p>Go to the page of Reset Password</p>	<p>User unsuccessful Sign In and must re-enter the email address or password is not appropriate</p> <p>Users successfully entered into the page of Reset Password</p>	Success Success
3	<p>New Chat</p> <p>a. Select the icon or submenu 'Start Chat'</p> <p>b. Select the message recipient's name in BBM Contacts or press submenu 'Open Chat'</p> <p>c. Find the contact recipient in BBM Contact</p> <p>d. Find the contact recipient is not registered in BBM Contact</p>	<p>Go to the page of select the contact</p> <p>Go to the recipient chat page</p> <p>Appears the message recipient's name is sought</p> <p>It does not appear that the message recipient's name sought</p>	<p>Users successfully entered into the page of select the contact for in-chat</p> <p>Users successfully entered into the recipient chat page</p> <p>Users successfully search for name of the message recipient</p> <p>Users are not able to find the name of the message recipient</p>	Success Success Success Success
4	<p>Chatting</p> <p>a. Send message</p> <p>b. Send a message to the feature of 'Timed Message'</p> <p>c. Send a message accompanied by emoticons or sticker</p>	<p>Message successfully delivered to the recipient in real time</p> <p>The message is sent to the recipient of the message with the predetermined time span</p> <p>Emoticons or sticker will be delivered to the recipient of the message</p>	<p>Users successfully send a message to the intended recipient</p> <p>Users successfully send a message to the intended recipient with a predetermined time span</p> <p>User successfully send emoticons or sticker to the intended recipient</p>	Success Success Success

No.	Test Case	Expected Results	Actual Results	Status
	d. Attach Picture, Contact, File, Location, and the files in Dropbox	Selected attachment will be sent to the recipient of the message	User successfully send an attachment to the intended recipient	Success
	e. Take photos to be sent to the recipient of the message	Photos taken will be sent	User successfully send the captured image to the message recipients	Success
	f. Send voice messages	Voice messages will be delivered to the recipient of the message	Users successfully send voice messages to the intended recipient	Success
	g. Send Glympse	Glympse will be delivered to the recipient of the message	Users successfully sent Glympse to the intended recipient	Success
	h. Select submenu 'Invite More' or submenu 'Start multiperson Chat' and select a contact to be selected	Invitation will be sent to contacts that have chosen to join the chat together (multiperson chat)	Users successfully invite contacts who have chosen to join the chat together (multiperson chat)	Success
	i. Select submenu 'BBM Start Meeting'	Go to the page of BBM Meeting and the meeting schedule can be set	Users successfully entered into the pages of BBM Meeting and can arrange meeting schedule	Success
	j. Select submenu 'Suggest a Contact'	The selected contacts will be delivered to the recipient of the message	User successfully sent the contact to the intended recipient	Success
	k. Select submenu 'Ping'	Ping will be delivered to the recipient of the message, accompanied by vibration	User successfully sent Ping to the intended recipient, accompanied by vibration	Success
	l. Select submenu 'Copy Chat'	Overall chat among recipients of the message will be copied	Users can copy the entire chat among recipients of the message	Success

No.	Test Case	Expected Results	Actual Results	Status
	m. Select submenu 'Email Chat' n. Select submenu 'Copy Message' o. Select submenu 'End Chat' or 'Clear Chat' in Group p. Select submenu 'Send Broadcast Message' q. Press the icon 'Voice Call'	Overall chat between the recipient of a message will be sent via email Chat will be copied Overall chat among recipients of the message or chat group will be removed The message will be sent to each recipient of the message that has been through a BBM contact Voice call will be carried out and connect to the addressee	Users successfully send the entire chat via email Users successfully copy chat Users successfully remove the entire chat among recipients of the message or chat group Users succeeded in sending a message to each recipient of the message Users successfully make a voice call and can connect to the addressee	Success Success Success Success
5	Feeds			
	a. Select the 'Feeds' b. Press the tab 'Contacts' c. Press the tab 'Channels' d. Comment on friends' activities e. Comment on the activities of Channels f. Give likes in activity Channels	Go to the page of Feeds and display activity from friends and channel on the tab 'All' Displays activity from friends Displays activity of the channel Comment will be sent to friends of its activities Comment will be sent to the intended Channels of its activities Likes will be delivered to	Users can see activity from friends and channel on the tab 'All' Users can see the activity from friends Users can see the activity of the channel Users succeeded in sending a comments about the activities of the intended personal friend User successfully send comments about the activities of the intended Channels Users successfully transmit likes activity related Channels	Success Success Success Success Success

No.	Test Case	Expected Results	Actual Results	Status
	<p>g. Give unlike post in Channels activities that have in-likes</p> <p>h. Select submenu 'Share Post'</p>	<p>activities related Channels</p> <p>Unlike post will be performed all activities related Channels</p> <p>Share the post of activities related Channels will be delivered to the recipient that the message has been</p>	<p>Users successfully perform unlike post activities related Channels</p> <p>User successfully share the post of Channels activities related to the recipient that the message has been</p>	<p>Success</p> <p>Success</p>
6	Groups			
	a. Select the 'Groups'	Go to the page of Groups	Users successfully entered into the pages of Groups	Success
	b. Select submenu 'Create New Group'	Group will be created, accompanied by members	User successfully created a group even though no members	Failed
	c. Select submenu 'Add'	New members will be added in the group that was created by Barcode Scan, PIN, BBM Contacts, and Email	Users successfully added a new member in the group through the Barcode Scan, PIN, BBM Contacts, and Email	Success
	d. Select submenu 'Start New Chat'	New chat will be created with the topic that has been entered	User successfully create a new chat with the topic that has been entered	Success
	e. Select submenu 'Chat History'	Chat history managed to set the period of time specified	Users successfully set a predetermined time period to save chat history	Success
	f. Select submenu 'Add Picture', 'Add List', and 'Add Event'	Picture will be sent and List & Event will be created	User successfully send Picture and makes List & Event	Success
	g. Select submenu 'Add Item'	Item assignment will be added in List	Users successfully added item assignment in List	Success

No.	Test Case	Expected Results	Actual Results	Status
	h. Select submenu 'View Comments' and 'Send Comment' i. Select submenu 'View List' on page View Comments j. Select submenu 'Delete List' in List and submenu 'Delete' in Event k. Select submenu 'View Group Profile' l. Select submenu 'Show Barcode' m. Select submenu 'Group Settings' n. Select submenu 'Leave Group'	Comments can be viewed and can be sent to the members of the group in the List Go to the List page being opened and item assignment of List can be seen in detail List or Event which have been will be removed Details, activity, and members of the group profile can be seen QR Code related groups belonging to visible and available QR Code Scanner Chat and image notification settings, extent permitted members to invite other members, as well as setting the admin and the password can be set The group will be removed if the 'Delete' is selected	Users can view comments and may submit comments to the group members in the relevant List Users successfully entered into the List page being opened and can see item assignment of List in detail Users successfully remove the List or Event have been Users can see the details, activities, and members of the group profile Users can view QR Code related groups and can scan the QR Code Other Users can set notifications chat and images, granting permission to invite members of the other members, as well as setting the admin and password Users successfully delete the group to be deleted	Success Success Success Success Success Success Success Success
7	Contacts a. Select menu 'Contacts' b. Press the 'Find More Friend' c. Select submenu 'Add Contact' and			
	a. Select menu 'Contacts'	Go to the page of Contacts	Users successfully entered into the pages of Contacts	Success
	b. Press the 'Find More Friend'	Go to the page of Invites	Users successfully entered into the pages of Invites	Success
	c. Select submenu 'Add Contact' and	The user's contact invitation will be	User successfully send contact	Success

No.	Test Case	Expected Results	Actual Results	Status
	then select Add by Barcode Scan submenu	sent to scan the QR Code belonging to other users targeted	invitation by scanning the QR Code other users targeted	
d.	Select submenu 'Add Contact' and then select submenu Add by PIN	The user's contact invitation will be sent to enter the PIN belonging to other users targeted	User successfully send contact invitation by entering a PIN belonging to other users targeted	Success
e.	Select submenu 'Add Contact' and then select submenu Add by Email	Invite contacts the user's email will be delivered to other users who the intended	User successfully send invitations via email belong to his contact other users targeted	Success
f.	Select submenu 'Add Contact' and then select submenu Add by SMS	The user's contact invitation will be delivered to the intended recipient via SMS	Users successfully send invitations to contacts intended recipient via SMS	Success
g.	Select submenu 'Add Category'	Contact categories will be added with select contacts that belong to that category	User successfully add contacts by selecting the category of contacts that belong to that category	Success
h.	Select submenu 'View BBM Profile'	BBM profile belonging to other users who have been able to see detail and feeds	Users can view the details and feeds on another user's BBM profile	Success
i.	Select submenu 'Show'	QR Code belonging to other selected users can be seen and available QR Code Scanner	Users can view other users' QR Code is selected and can scan the other QR Code	Success
j.	Select submenu 'Copy PIN'	PIN belonging to other users who have been will be copied	Users can copy the PIN belonging to other users who have been	Success
k.	Select submenu 'Invite to Group'	Other users who have been will be invited to a group that have been	Users successfully invite other users to join the group that has been determined	Success

No.	Test Case	Expected Results	Actual Results	Status
	l. Press the icon or submenu 'Move Contact' m. Select submenu 'Select More' n. Select submenu Delete [Contact_Name]'	The selected contacts will be transferred to another contact category Contacts in the BBM Contact may be selected in accordance with the wishes of users Contacts which will be removed if you select the Delete button	User successfully move a selected contact to another contact category Users can select existing contacts on BBM Contact User successfully deleted contacts that have been	Success Success Success
8	Channels			
	a. Select menu 'Channels'	Go to the Channels page by displaying Featured Channels and Featured Posts	Users successful entry into the Channels page displays and the Featured Posts Featured Channels	Success
	b. Press the tab 'My Channels'	Go to the page of My Channels to display the Channels that have followed the user	Users successfully entered into the page of My Channels to display the Channels that have followed	Success
	c. Press the tab 'Latest Activity'	Go to Latest Activity page to display the last activity of the Channel	Users successfully entered Latest Activity page by displaying the last activity of the Channel	Success
	d. Press the icon of the 'Search' button	Find channels and appear desired Channels name if available	Users can search for channels and successfully find the desired Channels if available	Success
	e. Select Channels that desired	Go to the page of the selected Channels as well as profiles and previews can be seen	Users successfully entered into the selected Channels page and can see a profile and preview the Channel	Success

No.	Test Case	Expected Results	Actual Results	Status
	f. Select submenu 'Join'	Channels that selected will be followed	Users successfully follow the information concerning the selected Channels	Success
	g. Select submenu 'View Channel Profile'	The profile of the selected Channel can be seen	Users can see the profile of Channel that have been	Success
	h. Select submenu 'Show Barcode'	QR Code belongs to the selected Channel can be viewed and available QR Code Scanner	Users can view QR Code belongs to the selected Channel and can scan the other QR Code	Success
	i. Select submenu 'Copy PIN'	PIN belonging to the selected Channel will be copied	Users can copy the PIN belonging to the selected Channel	Success
	j. Select submenu 'Channel Settings'	Channel activity settings can be set	Users can set the Channel activity	Success
	k. Select submenu 'Invite'	Invite other users to follow selected Channel will be performed	Users successfully invite other users to follow selected Channel	Success
	l. Select submenu 'Report Channel'	Report will be delivered to the BBM	User successfully send a report to the BBM of the Channel were considered to violate the rules	Success
	m. Select submenu 'Remove Complaint'	Complaints that have been carried out will be canceled	Users successfully canceled complaints that have been made	Success
	n. Select submenu 'Create Channel'	Channel will be created	User successfully make owned Channel	Success
	o. Select submenu 'Add Post'	Post is put into Channel will be performed	User fails to enter Post into Channel	Failed
	p. Select submenu 'Delete Channel'	Channel that selected will be removed if you select the Delete button	Users successfully remove Channel have been	Success

No.	Test Case	Expected Results	Actual Results	Status
	<p>q. Select submenu 'Mark as Favorite'</p> <p>r. Select submenu 'Remove as Favorite'</p> <p>s. Select submenu 'Edit Owner Profile'</p> <p>t. Select submenu 'Scan to Join'</p>	<p>The selected channel will be marked as a favorite channel</p> <p>The selected channel will be removed as a favorite channel</p> <p>Data on Owner Profile will be changed</p> <p>Go to the Channels page that has been scanned by the QR Code as well as profiles and previews can be seen</p>	<p>Users successfully marking Channel favorites</p> <p>Users successfully remove signs Channel favorites</p> <p>User successfully change the data in the Owner's Profile</p> <p>Users successfully entered into Channels pages that have been scanned by the QR Code and can see a profile and preview Channel</p>	<p>Success</p> <p>Success</p> <p>Success</p> <p>Success</p>
9	Invites			
	a. Select menu 'Invites'	Go to the page of Invites	Users successfully entered into the pages of Invites	Success
	b. Press the icon of the 'Search' button	Search contacts and appears the desired contact name if available in BBM Invites, Sponsored Invites, and Invites Sent	Users can search for contacts and successfully find the desired contact if available in BBM Invites, Sponsored Invites, and Invites Sent	Success
	c. Press the tab 'Scan Barcode' and press the 'Copy PIN'	Appears QR Code Scanner and the user contact PIN will be copied	Users can use the QR Code Scanner and successfully copy contacts PIN	Success
	d. Press the tab 'Scan Barcode' then press the 'Share My PIN'	Users contact PIN will be shared to selected media	User successfully share contacts PIN to the media that he had chosen	Success
	e. Press the 'Accept' in the name of the selected contact in BBM Invites	Contacts who have invited users will be received	Users successfully receive contacts invited as friends	Success
	f. Press the 'Ignore' in the name of the selected contact in	Contact or sponsor who has invited users will be rejected	Users successfully resisting contact or	Success

No.	Test Case	Expected Results	Actual Results	Status
	BBM Invites or Sponsored Invites g. Press the 'Cancel Invite' of the selected contact name in the Sent Invites	Contacts who have been invited by a user will be canceled	sponsor who has been invited as a friend Users successfully canceled invitations to contacts who have been invited	Success
10	Shop			
	a. Select the 'Shop'	Go to the page of BBM Shop	Users successfully entered into the pages of BBM Shop	Success
	b. Select Stickers, Subscriptions, or BBM Top Picks	Go to the page of Sticker, Subscriptions, or BBM Top Picks	Users successfully entered into the page of Sticker, Subscriptions, or BBM Top Picks	Success
	c. Press the link 'See All' in every part Stickers, Subscriptions, and BBM Top Picks	Displaying overall Sticker, Subscriptions, and BBM Top Picks	Users can view overall Sticker, Subscriptions, and BBM Top Picks	Success
11	d. Select submenu 'Restore'	Purchasing has been done by user will be restored	Users successfully restore the purchase has been done	Success
	Own BBM Profile			
	a. Press header BBM Profile	Go to the page of Own BBM profile with details and feeds	Users successfully entered into Own BBM Profile page with details and feeds	Success
12	b. Change BBM Display Picture, display name, status, and status messages	BBM Display Picture, display name, status, and status messages will be changed	Users successfully change BBM Display Picture, display name, status, and status messages	Success
	c. Press the link 'Customize My PIN'	Go to page of Subscribe Custom PIN on BBM Shop menu	Users successfully entered into Subscribe Custom PIN page in BBM Shop menu	Success
	Select the 'Help'	Heading into the Help pages on the selected browser by the user and information assistance can be found	Users can go to the Help page on the selected browser and can view information assistance	Success

No.	Test Case	Expected Results	Actual Results	Status
13	Select the 'Settings'	Go to the BBM Settings page and setting the activity, notifications, chat, contacts, general, and about the BBM can be set	Users successfully entered into the BBM Settings page and can organize events, notifications, chat, contacts, general, and about BBM	Success

Table 4.38 shows that 97 test cases succeed and 3 fail of 100 test cases are tested. From the results of the test case, it is known that the quality testing of Suitability subcharacteristic gain value with a score of 5. This is because 97% functionality in BlackBerry Messenger (BBM) applications has been running very well when users access the application.

4. Functionality Compliance

Testing of BlackBerry Messenger (BBM) applications on Functionality Compliance subcharacteristic tested using Guttman Scale. The test is performed by measuring the availability of existing functionality in the application standard BlackBerry Messenger (BBM) as an instant messenger application. Results of quality testing of Functionality Compliance subcharacteristic can be seen in Table 4.39.

Table 4.39 BBM Testing Results in Functionality Compliance Aspect

No.	Statement	Answer (Yes / No)
1	BlackBerry Messenger (BBM) has the functionality to exchange text messages.	Yes
2	BlackBerry Messenger (BBM) has the functionality to exchange picture messages.	Yes
3	BlackBerry Messenger (BBM) has the functionality to exchange voice messages.	Yes

No.	Statement	Answer (Yes / No)
4	BlackBerry Messenger (BBM) has the functionality to exchange video messages.	Yes
5	BlackBerry Messenger (BBM) has the functionality to call through the Internet.	Yes

Table 4.39 shows that the five standard functionality that must be owned by BlackBerry Messenger (BBM) application as an instant messenger application have been met. From these results it can be seen that the quality testing of Functionality Compliance subcharacteristic scored with a score of 5. It's indicates that the BlackBerry Messenger (BBM) application has a standard instant messenger applications are excellent for use by the user.

5. Interoperability

Testing of BlackBerry Messenger (BBM) applications on Interoperability subcharacteristic tested using Blackbox Testing. The test is performed by observing the interaction between the existing functionality in the BlackBerry Messenger (BBM) application with other systems that are outside the software. Results of quality testing of Interoperability subcharacteristic can be seen in Table 4.40.

Table 4.40 BBM Testing Results on Interoperability Aspects

No.	Test Case	Expected Results	Actual Results	Status
1	Forgot Password			
	Reset Password by Email System	Reset password is done will be emailed to the user, such as Gmail or Yahoo!	Reset password performed successfully sent to the user email, such as Gmail or Yahoo!	Success

No.	Test Case	Expected Results	Actual Results	Status
2	Chatting			
	a. Features of attach or Add Picture with Gallery in smartphone	The overall picture in the Gallery will appear, so the user can select the desired image	The overall picture in the Gallery successfully appear, so that the user can select the desired image	Success
	b. Features of attach files with File Directory in the smartphones	Overall directories will appear, so the user can select the desired file in the destination directory	The overall directory successfully appear, so that the user can select the desired file in the destination directory	Success
	c. Features of attach files in Dropbox	Overall Dropbox directory will appear, so the user can select the desired file in the destination directory	Overall Dropbox directory successfully appear, so that the user can select the desired file in the destination directory	Success
	d. See map with maps application	Location coordinates sent by the sender of the message will be seen by the message recipient using the maps app, like GMaps or Waze	Location coordinates sent by the sender of the message recipient successfully views the by recipient using the maps app, like GMaps or Waze	Success
	e. Start BBM Meeting	Log into the application of BBM Meeting to make the event a meeting with contacts in BlackBerry Messenger application	Successfully to get into the application of BBM Meeting to make the event a meeting with existing contacts on BlackBerry Messenger application	Success
	f. Email Chat with email, chat, and cloud computing application	Overall chat will be sent via e-mail applications, chat, and cloud computing, such as Gmail, Mail (the default application on the smartphone), Drive, and Skype	Overall chat successfully sent via email applications, chat, and cloud computing, such as Gmail, Mail (the default application on the smartphone), Drive, and Skype	Success

No.	Test Case	Expected Results	Actual Results	Status
3	Contacts			
	a. Add Contact by email with email application b. Add Contact by SMS with SMS application	The user's contact invitation will be sent to the other user's email application intended by email, such as Gmail or Mail (the default application on the smartphone) The user's contact invitation will be sent via SMS application	Invite contacts the user's email successfully delivered to other users through a targeted email application, such as Gmail or Mail (the default application on the smartphone) Invitation successfully transmitted the user's contacts through SMS applications	Success Success
4	Own BBM Profile			
	Share My PIN with media	Contact the user's PIN will be shared to media that can be selected, such as Bluetooth, Mail, Messaging, Notes, Facebook, WhatsApp, LINE, and so on	Contact the user's PIN successfully shared to media that can be selected, such as Bluetooth, Mail, Messaging, Notes, Facebook, WhatsApp, LINE, and so on	Success

Table 4.40 shows that the application of BlackBerry Messenger (BBM) has had to do with the interaction of the system 10 which are outside the software. From these results it can be seen that the quality testing of Interoperability subcharacteristic gain value with a score of 5. It's indicates that BlackBerry Messenger (BBM) application has excellent interoperability.

4.5.2 Testing of Reliability Characteristics

Quality of BlackBerry Messenger (BBM) application Android-based tested on Reliability characteristics consists of four subcharacteristic to be assessed. Fourth subcharacteristic include Maturity, Fault Tolerance, Reliability Compliance, and Recoverability. Reliability characteristics testing against each subcharacteristic are as follows:

1. Maturity

Testing of BlackBerry Messenger (BBM) applications on the Maturity subcharacteristic tested using Blackbox Testing. The test is performed by observing the frequency of failure can be avoided due to a software error.

Results of quality testing of Maturity subcharacteristic can be seen in Table 4.41.

Table 4.41 BBM Testing Results on Maturity Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Send a message to the various characters and emoticons to a message recipient 100 times in the same time	The message will be sent as much as 100 times to a recipient of the message in the same time	The message is sent as much as 100 times to a recipient of the message in the same time	Success
2	Send a message to the various characters and emoticons to 100 recipients in the same time	The message will be sent to 100 recipients in the same time	The message is successfully sent to 100 recipients in the same time	Success
3	Send Ping message to a recipient as much as 100 times in the same time	Ping messages will be sent as much as 100 times to a recipient of the message in the same time	Ping messages failed to send as much as 100 times to a recipient of the message and only successfully send the message Ping 3 times in the same time. However, Ping messages can be sent	Failed

No.	Test Case	Expected Results	Actual Results	Status
			back after 1 minute later	
4	Send Ping to 100 recipients in the same time	Ping message will be sent to 100 recipients in the same time	Ping message was successfully sent to 100 recipients in the same time	Success
5	Send Broadcast Message to 100 recipients in the same time	Broadcast Message will be sent to 100 recipients in the same time	Broadcast Message successfully sent to 100 recipients in the same time	Success

Table 4.41 shows that the four test case succeeded and one failed of five test cases tested. From the results of the test case, it is known that the quality testing of Maturity subcharacteristic scored with a score of 4. This is because 80% of the messages function on the BlackBerry Messenger (BBM) application has been able to avoid failure frequency properly due to improper application.

2. Fault Tolerance

Testing of BlackBerry Messenger (BBM) applications on Fault Tolerance subcharacteristic tested using the method BlacBox Testing. The test is performed by observing the ability of BlackBerry Messenger (BBM) applications to maintain performance by providing fault tolerance in the event of a system fault or human error. Results of quality testing of Fault Tolerance subcharacteristic can be seen in Table 4.42.

Table 4.42 BBM Testing Results on Fault Tolerance Aspects

No.	Test Case	Expected Results	Actual Results	Status
1	Register			
	a. Create an account by entering an	Account will fail to be made if the email	Account has been successfully created	Failed

No.	Test Case	Expected Results	Actual Results	Status
2	email address that does not match by more than 10 times	address does not match	despite email addresses do not match	
	b. Create an account by entering a password that does not meet the requirement by more than 10 times	Accounts created will fail if the password is not eligible	Account created successfully fail because the password is not eligible to re-enter the password 30 times	Success
3	Sign In			
	a. Sign In by entering email address and password that does not match by more than 10 times	Sign In failing to do and appear notification to let users fill in email address and password back	Sign In successfully cannot be processed and a notification to let users fill in email address and password back. After 5 times the chance, appear verification code must be entered. After 12 occasions, the user account will be locked	Success
	b. Reset password to enter a verification code that does not fit as many as more than 10 times	Reset password failed to be done and a notification that the verification code entered does not match	Reset password is not processed successfully and display a notification that the verification code entered does not match with a verification code back 30 times	Success
3	c. Reset passwords by answering specific questions incorrectly by more than 10 times	Failed password reset and sent to the user's email fail and display a notification that the answer wrong	Password reset is not successful and is not sent to the user's email and a notification that answers one of the questions answered back 30 times	Success
	Contacts			
	a. Adding contacts via QR Code Scanner to scan the QR Code is wrong by more than 10 times	Contacts will fail to be added and sent to the designated contact	Contacts succeed fail to plus and failed to be sent to the designated contact by trying to scan the QR code incorrectly 30 times	Success

No.	Test Case	Expected Results	Actual Results	Status
	b. Add contacts via PIN by entering your PIN incorrectly more than 10 times	PIN will not be found so that the contact failure coupled and sent to the intended party contact	PIN managed not to be found so that the contact failure plus contact and sent to the addressee by trying to enter the PIN incorrectly 30 times	Success

Table 4.42 shows that the six test case succeeded and one failed of seven test cases tested. From the results of the test case, it is known that the quality testing of Fault Tolerance subcharacteristic gain value with a score of 5. This is because 86% of BlackBerry Messenger (BBM) applications can provide with excellent fault tolerance in the event of a system error or a user made a mistake on the application.

3. Reliability Compliance

Testing of BlackBerry Messenger (BBM) applications on Reliability Compliance subcharacteristic tested using Guttman Scale. The test is performed by measuring reliability that of the standard applications BlackBerry Messenger (BBM) as an instant messenger application. Results of quality testing Reliability Compliance subcharacteristic can be seen in Table 4.43.

Table 4.43 BBM Testing Results on Reliability Compliance Aspect

No.	Statement	Answer (Yes / No)
1	BlackBerry Messenger (BBM) has reliability in providing fault tolerance more than 60% chance	Yes
2	BlackBerry Messenger (BBM) has the reliability in avoiding more than 60% frequency of message delivery failure	Yes

No.	Statement	Answer (Yes / No)
3	BlackBerry Messenger (BBM) has the reliability in continuing its work back and restore user data when it occurs more than 2 errors in the system or network connection	Yes

Table 4.43 shows that three reliability standards that should be owned by BlackBerry Messenger (BBM) application as an instant messenger application have been met. BlackBerry Messenger (BBM) able to provide fault tolerance of 86%, avoid 80% malfunction messaging, and continuing throughout its work back and restore the entire user data when a system error occurs. From these results it can be seen that the quality testing of Reliability Compliance subcharacteristic gain value with a score of 4. It's indicates BlackBerry Messenger (BBM) has had instant messenger application reliability standards suitable for use by users.

4. Recoverability

Testing of BlackBerry Messenger (BBM) applications on Recoverability subcharacteristic is tested by using the method Blackbox Testing. The test is performed by observing the ability of BlackBerry Messenger (BBM) applications in continuing its work back and restore user data in the event of an error in the system software and network connections. Results of quality testing of Recoverability subcharacteristic can be seen in Table 4.44.

Table 4.44 BBM Testing Results on Recoverability Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Send a message when the sender or recipient of the message was no network	The message has not been sent, but will go into the server to be executed when the network is available	The message has not been sent, but has entered into the server to be executed when the network is available	Success
2	While the message is being typed, there is an incoming call	The message being typed will not be lost	The message being typed managed not lost, so the user can continue writing the message	Success
3	While the message is being typed, the user switches to another application to minimize the application of BBM	The message being typed will not be lost	The message being typed managed not lost, so the user can continue writing the message	Success
4	While the message is being typed, the user out of the application	The message being typed will not be lost and will be stored on the chat between the sender and receiver of the message	The message being typed managed not lost and already stored in the chat between the sender and receiver of the message	Success
5	While the message is being typed, the smartphone experience restart or shutdown	The message being typed will not be lost and will be stored on the chat between the sender and receiver of the message	The message being typed managed not lost and already stored in the chat between the sender and receiver of the message	Success

Table 4.44 shows that the entire test case was successfully tested. From the results of the test case, it is known that the quality testing of Recoverability subcharacteristic gain value with a score of 5. This is because the recovery function in BlackBerry Messenger (BBM) applications has been able to continue its work back and restore user data when a system error occurs five or network connection.

4.5.3 Testing of Efficiency Characteristics

Quality of BlackBerry Messenger (BBM) Android-based tested on Efficiency characteristic consists of three subcharacteristic to be assessed. Third subcharacteristic include Time Behaviour, Resource Utilization, and Efficiency Compliance. Efficiency characteristics testing against each subcharacteristic are as follows:

1. Time Behaviour

Testing of BlackBerry Messenger (BBM) applications on Time Behaviour subcharacteristic tested using Blackbox Testing. The test is performed by measuring the speed of BlackBerry Messenger (BBM) applications under 3K/s in response and processing time when carrying out its functions. The speed measurement is done using a stopwatch application. Results of quality testing of Time Behaviour subcharacteristic can be seen in Table 4.45.

Table 4.45 BBM Testing Results in Time Behaviour Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Send a text message with the character: a. Lowercase (a-z) b. Capital letters (A-Z) c. Figures (0-9) d. Punctuation mark e. Emoticon	Response and processing time on a short message with these characters will spend a maximum of 2 milliseconds	Short messages with these characters manage to spend time during the 1168 millisecond	Success
2	Send normal message with the character: a. Lowercase (a-z) b. Capital letters (A-Z) c. Figures (0-9)	Response and processing time on a short message with these characters will spend a maximum of 2.5 milliseconds	Normal message delivery with these characters manage to spend time during the 1457 millisecond	Success

No.	Test Case	Expected Results	Actual Results	Status
	d. Punctuation mark e. Emoticon			
3	Send a message length character: a. Lowercase (a-z) b. Capital letters (A-Z) c. Figures (0-9) d. Punctuation mark e. Emoticon	Response and processing time on a short message with these characters will spend a maximum of 3 milliseconds	Length of message delivery with these characters manage to spend time during the 2,008 millisecond	Success

Table 4.45 shows that BlackBerry Messenger (BBM) application has the response and processing times at short messages during 1168 milliseconds, normal message during 1457 milliseconds, and long messages during 2008 milliseconds. From these results it can be seen that the quality testing of Time Behaviour subcharacteristic gain value with a score of 4. It's indicates BlackBerry Messenger (BBM) has a response time and a good process.

2. Resource Utilization

Testing of BlackBerry Messenger (BBM) applications on Resource Utilization subcharacteristic tested using Blackbox Testing. The test is performed by observing the utilization of available resources BlackBerry Messenger (BBM) applications when carrying out its functions. Results of quality testing of Resource Utilization subcharacteristic can be seen in Table 4.46.

Table 4.46 BBM Testing Results on Resource Utilization Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Check the RAM storage in Settings Smartphone	The maximum amount of RAM that is used when running the application function is 60 MB	When running an application function, RAM used successfully use a size of 42 MB	Success
2	Check Memory Settings application on Smartphone	The maximum amount of memory that is used when running the application functionality is 65 MB	When running an application function, Memory used successfully use the size of 48.13 MB	Success

Table 4.46 shows that BlackBerry Messenger (BBM) application spent RAM storage resources by 42 MB and Memory at 48.13 MB. From these results it can be seen that the quality testing of Resource Utilization subcharacteristic gain value with a score of 4. It's indicates BlackBerry Messenger (BBM) has a good use of resources when running the functionality.

3. Efficiency Compliance

Testing of BlackBerry Messenger (BBM) applications on Efficiency Compliance subcharacteristic tested using Guttman Scale. The test is performed by measuring the efficiency of standard applications that exist on the BlackBerry Messenger (BBM) as an instant messenger application. Results of quality testing of Efficiency Compliance subcharacteristic can be seen in Table 4.47.

Table 4.47 BBM Testing Results on Efficiency Compliance Aspect

No.	Statement	Answer (Yes / No)
1	BlackBerry Messenger (BBM) has an efficiency in the exchange of text messages with exceeding 1,224 characters exist on SMS	Yes
2	BlackBerry Messenger (BBM) has an efficiency in delivering the response and processing times of up to 2 milliseconds on short messages (<80 characters)	Yes
3	BlackBerry Messenger (BBM) has an efficiency in delivering the response and processing times of 2.5 milliseconds at the maximum normal messages (81-160 characters)	Yes
4	BlackBerry Messenger (BBM) has an efficiency in delivering the response and processing times of up to 3 milliseconds in length messages (> 160 characters)	Yes
5	BlackBerry Messenger (BBM) has a maximum efficiency in storage RAM 60 MB	Yes
6	BlackBerry Messenger (BBM) has a maximum efficiency in storage memory 65 MB	Yes

Table 4.47 shows that six efficiency standards that must be owned by an BlackBerry Messenger (BBM) application as an instant messenger application have been met. BlackBerry Messenger (BBM) can contain up to 2,000 characters of text messages, send short messages during 1.168 milliseconds, send normal messages during 1.457 milliseconds, send a long message for 2.008 milliseconds, spent 42 MB RAM for storage, and using 48.13 MB for memory storage applications. From these results it can be seen that the quality testing of Efficiency Compliance subcharacteristic scored with a score of 5. It's indicates that the BlackBerry Messenger (BBM) application has had a very good efficiency standards to be used by the user.

4.5.4 Testing of Usability Characteristics

Quality of BlackBerry Messenger (BBM) application Android-based tested on Usability characteristics consists of five subcharacteristic to be assessed. Fifth subcharacteristic include Operability, Learnability, Understandability, Attractiveness, and Usability Compliance. Usability characteristics testing against each subcharacteristic conducted by questionnaire J.R Lewis by the number of respondents as many as 204 respondents. Results of the questionnaire processing of existing subcharacteristics on Usability characteristics can be seen in Table 4.48.

Table 4.48 BBM Testing Results on Usability Characteristics

No.	Subcharacteristic	The Most Answers	Percentage Feasibility
1	Operability	Agree	39.34%
2	Learnability	Agree	51.23%
3	Understandability	Agree	52.78%
4	Attractiveness	Agree	43.75%
5	Usability Compliance	Agree	44.93%

Table 4.48 shows that 39.34% of respondents agree Operability aspect provide user convenience in operating applications, 51.23% of respondents agreed Learnability aspect provides convenience in studying the application, 52.78% of respondents agree Understandability aspect provide user convenience in understanding the application, 43.75% of respondents agreed aspects of Attractiveness provide power attraction for users, as well as 44.93% of respondents agree Usability Compliance aspects complies with the standards instant messenger applications. Based on indicators that have been determined and the feasibility percentage obtained, it can be seen that the quality testing of:

1. Operability Subcharacteristic quite enough with a score of 3.
2. Learnability Subcharacteristic quite good with a score of 4.
3. Understandability Subcharacteristic quite good with a score of 4.
4. Attractiveness Subcharacteristic quite good with a score of 4.
5. Usability Compliance Subcharacteristic quite good with a score of 4.

4.5.5 Testing of Portability Characteristics

Quality of BlackBerry Messenger (BBM) application Android-based tested on Portability characteristic consists of five subcharacteristic to be assessed. Fifth subcharacteristic include Installability, Adaptability, Portability Compliance, Replaceability, and Coexistence. Portability characteristics testing against each subcharacteristic are as follows:

1. Installability

Testing of BlackBerry Messenger (BBM) applications on Installability subcharacteristic tested using Guttman Scale. The test is performed by observing the ability of BlackBerry Messenger (BBM) applications during the installation on different environments. Environmental question is the Android operating system version used by the 204 respondents with various smartphone screen size of <5 inch. Results of quality testing of Installability subcharacteristic can be seen in Table 4.49.

Table 4.49 BBM Testing Results on Installability Aspect

No.	Statement	Answer (Yes / No)
1	The installation process successfully run well on the operating system Android 2.3 - 2.3.7 Gingerbread smartphone screen size of <5 inch.	Yes
2	The installation process successfully run well on the operating system Android 4.1 - Jelly Bean 4.3 on a smartphone screen size of <5 inch.	Yes
3	The installation process successfully run well on the operating system Android 4.0 - 4.0.4 Ice Cream Sandwich on the smartphone screen size of <5 inch.	Yes
4	The installation process successfully run well on the operating system Android 4.4 KitKat on the smartphone screen size of <5 inch.	Yes
5	The installation process successfully run well on the operating system Android 5.0 smartphone screen size Lollipop at <5 inch.	Yes

Table 4.49 shows that the installation process on BlackBerry Messenger (BBM) application managed to run well on the fifth Android operating system, namely Gingerbread, Jelly Bean, Ice Cream Sandwich, KitKat, and Lollipop. From these results it can be seen that the quality testing of Installability subcharacteristic gain value with a score of 5. It's indicates BlackBerry Messenger (BBM) has been able to perform the installation process very well.

2. Adaptability

Testing of BlackBerry Messenger (BBM) applications on Adaptability subcharacteristic tested using Guttman Scale. The test is performed by observing the ability of BlackBerry Messenger (BBM) applications in adapting to different environments. Environmental question is the Android operating system version used by the 204 respondents with

various smartphone screen size of <5 inch. Results of quality testing of Adaptability subcharacteristic can be seen in Table 4.50.

Table 4.50 BBM Testing Results on Adaptability Aspect

No.	Statement	Answer (Yes / No)
1	All functions run well on the operating system Android 2.3 - 2.3.7 Gingerbread smartphone screen size of <5 inch.	Yes
2	All functions run well on the operating system Android 4.1 - Jelly Bean 4.3 on a smartphone screen size of <5 inch.	Yes
3	All functions run well on the operating system Android 4.0 - 4.0.4 Ice Cream Sandwich on the smartphone screen size of <5 inch.	Yes
4	All functions run well on operating system Android 4.4 KitKat on a smartphone screen size of <5 inch.	Yes
5	All functions run well on operating system Android 5.0 Lollipop on the smartphone screen size of <5 inch.	Yes

Table 4.50 shows that the functions on BlackBerry Messenger (BBM) application managed to run well on the fifth Android operating system, namely Gingerbread, Jelly Bean, Ice Cream Sandwich, KitKat, and Lollipop. From these results it can be seen that the quality testing of Adaptability subcharacteristic gain value with a score of 5. It's indicates BlackBerry Messenger (BBM) has been able to adapt very well.

Based on official information BlackBerry Messenger (BBM) applications from the Google Play Store, there are applications that do not feature on the Gingerbread version of the Android operating system. Features that do not support the PIN is adjusted to remove ads, BBM Voice, Glympse access, as well as the BBM Channels [7],

3. Portability Compliance

Testing of BlackBerry Messenger (BBM) applications on Portability Compliance subcharacteristic tested using Guttman Scale. The test is performed by measuring the availability of portability that exist in the application standard BlackBerry Messenger (BBM) as an instant messenger application. Results of quality testing Portability Compliance subcharacteristic can be seen in Table 4.51.

Table 4.51 BBM Testing Results on Portability Compliance Aspect

No.	Statement	Answer (Yes / No)
1	BlackBerry Messenger (BBM) has portability to run on the smartphone screen size of <5 inch	Yes
2	BlackBerry Messenger (BBM) has portability to run on the fifth Android operating system (Gingerbread, Jelly Bean, Ice Cream Sandwich, KitKat, and Lollipop)	Yes
3	BlackBerry Messenger (BBM) has portability to install applications on the fifth Android operating system without having to change the identity of the operating system or previous smartphone	Yes
4	BlackBerry Messenger (BBM) has the portability of more than 60% to coexist with shared resources on other software in the environment	Yes
5	BlackBerry Messenger (BBM) has portability to replace more than 3 software similar	Yes

Table 4.51 shows that five portability standards that must be owned by an BlackBerry Messenger (BBM) application as an instant messenger application have been met. BlackBerry Messenger (BBM) able to run and install applications on the smartphone screen size of <5 inch Android Gingerbread operating system, Jelly Bean, Ice Cream Sandwich, KitKat, and Lollipop. In addition, this application is also able to co-exist with other software with a percentage of 73% and capable of replacing eight similar software. From these results it can be seen that the quality testing

of Portability Compliance subcharacteristic scored with a score of 4. It's indicates BlackBerry Messenger (BBM) has had a good portability standards to be used by the user.

4. Replaceability

Testing of BlackBerry Messenger (BBM) applications on Replaceability subcharacteristic tested using Guttman Scale. The test is performed by observing the functions of the BlackBerry Messenger (BBM) application in replacing the similar instant messenger application with the terms which contact contained in the user's friend also related applications. Results of quality testing Replaceability subcharacteristic can be seen in Table 4.52.

Table 4.52 BBM Testing Results on Replaceability Aspect

No.	Statement	Answer (Yes / No)
1.	Multimedia message (text, images, sound, video), emoticons, free call / voice calls, as well as the group chat on application BlackBerry Messenger (BBM) can replace existing features on the application: a. WhatsApp b. LINE Messenger c. WeChat d. KakaoTalk e. Hangouts by Google f. Yahoo Messenger g. Facebook Messenger h. Skype	Yes Yes Yes Yes Yes Yes Yes Yes

Table 4.52 shows that BlackBerry Messenger (BBM) application can replace features that exist in eight instant messenger application that is similar. Features on WhatsApp, LINE Messenger, WeChat, KakaoTalk,

Hangouts by Google, Yahoo Messenger, Facebook Messenger, and Skype features include multimedia messaging (text, images, sound, and video), emoticons, free call or a voice call, and group chat. From these results it can be seen that the quality testing of Replaceability subcharacteristic gain value with a score of 5. It's indicates that BlackBerry Messenger (BBM) application able to act as an instant messenger application that can replace similar software very well.

5. Coexistence

Testing of BlackBerry Messenger (BBM) applications on Coexistence subcharacteristic tested using Blackbox Testing. The test is performed by observing the ability of BlackBerry Messenger (BBM) applications when co-exist with other software in the environment by sharing resources. Results of quality testing of Coexistence subcharacteristic can be seen in Table 4.53.

Table 4.53 BBM Testing Results on Coexistence Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Chatting			
	a. Attach or Add Picture Gallery in smartphone	RAM usage in the gallery will be allocated to the RAM on BBM consumption	RAM usage at the Gallery successfully allocated to the RAM on BBM consumption	Success
	b. Attach files with File Directory smartphones	RAM usage on the File Directory will be allocated to the RAM on BBM consumption	RAM usage in the Directory File successfully allocated to the RAM on BBM consumption	Success
	c. Attach files in Dropbox	RAM usage on Dropbox will be	RAM usage on Dropbox successfully	Success

No.	Test Case	Expected Results	Actual Results	Status
	d. See map feature with maps application, which GMaps e. See map feature with maps application, which Waze f. Chats with BBM Meeting g. Email Chat with the email application, namely Gmail and Mail (the default application) h. Email Chat with chat applications, namely Skype i. Email Chat with cloud computing applications, the Drive j. Chat with Camera	allocated to the RAM on BBM consumption RAM usage on GMaps will be allocated to the RAM on BBM consumption RAM usage on Waze will be allocated to the RAM on BBM consumption RAM usage on BBM Meeting will be allocated to the RAM on BBM consumption RAM usage on Gmail and Mail will be allocated to the RAM on BBM consumption RAM usage on Skype will be allocated to the RAM on BBM consumption RAM usage on the drive will be allocated to the RAM on BBM consumption RAM usage on Camera will be allocated to the RAM on BBM consumption	allocated to the RAM on BBM consumption RAM usage on GMaps successfully allocated to the RAM on BBM consumption RAM usage on Waze failed RAM allocated to the BBM consumption BBM consumption at the Meeting fails RAM allocated to the RAM on BBM consumption RAM usage on Gmail and Mail successfully allocated to the RAM on BBM consumption RAM usage on Skype successfully allocated to the RAM on BBM consumption RAM usage on the drive successfully allocated to the RAM on BBM consumption RAM usage on Camera successfully allocated to the RAM on BBM consumption	Success Failed Failed Success Success Success Success Success
2	Contacts a. Add Contact by email to the email application, namely Gmail and	RAM usage on Gmail and Mail will be allocated to the	RAM usage on Gmail and Mail successfully allocated to the RAM on BBM consumption	Success

No.	Test Case	Expected Results	Actual Results	Status
	Mail (the default application) b. Add Contact by SMS to the SMS application, namely Messaging (application default)	RAM on BBM consumption RAM usage in Messaging will be allocated to the RAM on BBM consumption	RAM usage on the Messaging failed to be allocated to the RAM on BBM consumption	Failed
3	Profile			
	a. Share My PIN with the media, such as Bluetooth, Cloud Album, Mail, Gmail, Notes, Dropbox, Drive, Skype	RAM usage on these media will be allocated to the RAM on BBM consumption	RAM usage on these media successfully allocated to the RAM on BBM consumption	Success
	b. Share My PIN with the media, such as Messaging, WhatsApp, LINE, Facebook	RAM usage on these media will be allocated to the RAM on BBM consumption	RAM usage on these media failed to be allocated to the RAM on BBM consumption	Failed
	c. Replace Picture Gallery and Camera	RAM usage on the Gallery and Camera will be allocated to the RAM on BBM consumption	RAM usage on the Gallery and Camera successfully allocated to the RAM on BBM consumption	Success

Table 4.53 shows that 11 test cases succeed and 4 failure of 15 test cases were tested. From these results it can be seen that the quality testing of Coexistence subcharacteristic gain value with a score of 4. This is because 73% of BlackBerry Messenger (BBM) applications can co-exist well when sharing resources on other software in the environment.

4.5.6 Testing of Maintainability Characteristics

Quality of BlackBerry Messenger (BBM) application Android-based tested on Maintainability characteristic consists of two subcharacteristic to be assessed. Both subcharacteristic include Analyzability and Maintainability Compliance. Maintainability characteristics testing against each subcharacteristic are as follows:

1. Analyzability

Testing of BlackBerry Messenger (BBM) applications on subcharacteristic Analyzability tested using Blackbox Testing. Testing is done by observing the deficiency diagnosis or cause of failure in BlackBerry Messenger (BBM) application. Results of quality testing of Analyzability subcharacteristic can be seen in Table 4.54.

Table 4.54 BBM Testing Results on Analyzability Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Sign Up			
	a. Create an account by entering a username yet, email address, and password	The account will not be created and appear notice that the username, email address, and password required and necessary (required)	Accounts failed to be created and a notification that the username, email address, and password required and necessary (required)	Success
	b. Create an account by entering a password that does not qualify	The account will not be created and appear notice that the password must have the character length between 6-20 and contain letters (A-Z, a-z), numbers (0-9), or punctuation (^ _ # * + / "?! =. {} ~ '&)	Accounts failed to be created and a notification that the password must have the character length between 6-20 and contain letters (A-Z, a-z), numbers (0-9), or punctuation (^ _ # * + / "?! =. {} ~ '&)	Success
	c. Create an account by entering a	The account will not be created and	Accounts failed to be created and appear	Success

No.	Test Case	Expected Results	Actual Results	Status
	username or an email address that is already registered	appear with notification that the BlackBerry ID username or email that has been entered already exists, so it must enter a new username	with notification that the BlackBerry ID username or email that was entered already exists, so it must enter a new username	
2	Sign In			
	Sign In to not enter an email address and password	Sign In will not be successfully carried out and display a notification that the email address and password are required and necessary	Sign In unsuccessful and appear notice that the username, email address, and password required and necessary	Success
3	Forgot Password			
	a. Reset passwords by not filling the verification code b. Reset passwords by answering specific questions yet	Reset password will fail and display a notification that the verification code does not match Reset password will fail and display a notification that the answer is incorrect password recovery	Reset password failed and display a notification that the verification code does not match Reset password failed and notifications appear that the answer is incorrect password recovery	Success Success
4	Groups			
	Create Groups with not insert member	Group will fail to be made and a notification that the members should be included in advance	Group successfully created although not yet have members and does not display a notification that the members should be included in advance	Failed

Table 4.54 shows that the six test case success and one failed of 7 test cases tested. From the results of the test case, it is known that the quality testing of Analyzability subcharacteristic gain value with a score of 5. This is because 86% function deficiency diagnosis or cause of failure in

BlackBerry Messenger (BBM) application has been available and run very well.

2. Maintainability Compliance

Testing of BlackBerry Messenger (BBM) applications on Maintainability Compliance subcharacteristic tested using Guttman Scale. The test is performed by measuring the maintenance associated application standard BlackBerry Messenger (BBM) as an instant messenger application. Results of quality testing Maintainability Compliance subcharacteristic can be seen in Table 4.55.

Table 4.55 BBM Testing Results on Maintainability Compliance Aspect

No.	Statement	Answer (Yes / No)
1	BlackBerry Messenger (BBM) had maintenance in diagnosing deficiencies or causes of the failure of more than 60% when running a function	Yes
2	BlackBerry Messenger (BBM) service reports if users find errors or bugs	Yes
3	BlackBerry Messenger (BBM) had maintenance in renewing the application development continue	Yes

Table 4.55 shows that the three standards of maintenance that must be owned by BlackBerry Messenger (BBM) as an instant messenger application have been met. BlackBerry Messenger (BBM) able to diagnose 86% of the causes of failure, have service reports if the user finds an error or bug, as well as continue to provide updates on the development application. From these results it can be seen that the quality testing of Maintainability Compliance subcharacteristic scored with a score of 4.

This indicates BlackBerry Messenger (BBM) has a standard instant messenger application maintenance is good.

4.5.7 Quality Testing Results of BlackBerry Messenger (BBM) Application

The value of quality test results BlackBerry Messenger (BBM) application on each characteristic has been obtained. This value is inserted into the variable c by calculating the total value of subcharacteristic as follows:

1. Functionality

- a. Security : $25.7\% * 4 = 20.6\%$
- b. Accuracy : $25.7\% * 5 = 25.7\%$
- c. Suitability : $20.6\% * 5 = 20.6\%$
- d. Functionality Compliance : $18.8\% * 5 = 18.8\%$
- e. Interoperability : $9.1\% * 5 = 9.1\%$

2. Reliability

- a. Maturity : $28.9\% * 4 = 23.1\%$
- b. Fault Tolerance : $28.9\% * 5 = 28.9\%$
- c. Reliability Compliance : $24.6\% * 4 = 19.7\%$
- d. Recoverability : $17.5\% * 5 = 17.5\%$

3. Efficiency

- a. Time Behaviour : 33.3% * 4 = 26.6%
- b. Resource Utilization : 33.3% * 4 = 26.6%
- c. Efficiency Compliance : 33.3% * 5 = 33.3%

4. Usability

- a. Operability : 29.6% * 3 = 17.8%
- b. Learnability : 21.7% * 4 = 17.4%
- c. Understandability : 18.5% * 4 = 14.8%
- d. Attractiveness : 17.5% * 4 = 14%
- e. Usability Compliance : 12.7% * 4 = 10.2%

5. Portability

- a. Installability : 33.6% * 5 = 33.6%
- b. Adaptability : 23.2% * 5 = 23.2%
- c. Portability Compliance : 18.7% * 4 = 15%
- d. Replaceability : 13.4 % * 5 = 13.4%
- e. Coexistence : 11.1% * 4 = 8.9%

6. Maintainability

- a. Analyzability : 50% * 5 = 50%
- b. Maintainability : 50% * 4 = 40%

Of the total acquisition value of each subcharacteristic, the total value of factor analysis of each characteristic can be obtained by multiplying the value of each subcharacteristic grand total weight characteristics. Calculation of the total value of factor analysis of each characteristic in ISO 9126-1 Quality Model is as follows:

1. Functionality : $(20.6\% + 25.7\% + 20.6\% + 18.8\% + 9.1\%) * 45.3\% = 42.9\%$
2. Reliability : $(23.1\% + 28.9\% + 19.7\% + 17.5\%) * 24\% = 21.4\%$
3. Efficiency : $(26.6\% + 26.6\% + 33.3\%) * 11.9\% = 10.3\%$
4. Usability : $(17.8\% + 17.4\% + 14.8\% + 14\% + 10.2\%) * 9\% = 6.7\%$
5. Portability : $(33.6\% + 23.2\% + 15\% + 13.4\% + 8.9\%) * 6.2\% = 5.8\%$
6. Maintainability: $(50\% + 40\%) * 3.6\% = 3.2\%$

Results of calculation of the total value of each subcharacteristic and the total value of factor analysis of each characteristic described in Table 4.56. From the table, the grand total value of factor analysis in BlackBerry Messenger (BBM) can be determined percentage of quality applications.

Table 4.56 Testing Results Quality BlackBerry Messenger (BBM)

No	Characteristic	Weight	Subcharacteristic	Weight Value (w)(0-1)	Value	Total of Value Each Subcharacteristic	Total of Value Each Characteristic
		Max Value			(c)		
1	Functionality	45.3%	Security	25.7%	4	20.6%	42.9%
			Accuracy	25.7%	5	25.7%	
			Suitability	20.6%	5	20.6%	
			Functionality Compliance	18.8%	5	18.8%	
			Interoperability	9.1%	5	9.1%	
2	Reliability	24.0%	Maturity	28.9%	4	23.1%	21.4%
			Fault Tolerance	28.9%	5	28.9%	
			Reliability Compliance	24.6%	4	19.7%	
			Recoverability	17.5%	5	17.5%	
3	Efficiency	11.9%	Time Behaviour	33.3%	4	26.6%	10.3%
			Resource Utilization	33.3%	4	26.6%	
			Efficiency Compliance	33.3%	5	33.3%	
4	Usability	9.0%	Operability	29.6%	3	17.8%	6.7%
			Learnability	21.7%	4	17.4%	
			Understandability	18.5%	4	14.8%	
			Attractiveness	17.5%	4	14.0%	
			Usability Compliance	12.7%	4	10.2%	
5	Portability	6.2%	Installability	33.6%	5	33.6%	5.8%
			Adaptability	23.2%	5	23.2%	
			Portability Compliance	18.7%	4	15.0%	
			Replaceability	13.4%	5	13.4%	
			Coexistence	11.1%	4	8.9%	
6	Maintainability	3.6%	Analyzability	50.0%	5	50.0%	3.2%
			Maintainability Compliance	50.0%	4	40.0%	
	Jumlah	100%					90%

Table 4.56 shows that the quality of BlackBerry Messenger (BBM) applications obtained was 90%. From the test results, Functionality characteristics obtain a percentage of 42.9%, amounting to 21.4% Reliability, Efficiency of 10.3%, amounting to 6.7% Usability, Portability amounted to 5.8%, and 3.2%

Maintainability. Overall, the quality of each characteristics BlackBerry Messenger (BBM) application has been good with the majority of the value of the variable c is 4 and 5. However, there are Operability subcharacteristic which has a value of 3, so that needs to be addressed further.

4.6 Testing of WhatsApp Messenger Application

WhatsApp Messenger is a cross-platform mobile messaging application to exchange SMS messages at no cost developed by WhatsApp Inc. Instant messenger application ranked second version of Nielsen's most widely used to test the quality based on standard ISO 9126-1 Quality Model. Tests performed on the WhatsApp application on Android-based smartphone size <5 inch with the latest version, the version 2.12.5.

4.6.1 Testing of Functionality Characteristics

WhatsApp application quality based on Android are tested on the Functionality characteristic consists of five subcharacteristic to be assessed. Fifth subcharacteristic include Security, Accuracy, Suitability, Functionality Compliance, and Interoperability. Functionality characteristics testing against each subcharacteristic are as follows:

1. Security (Security)

WhatsApp application testing on Security subcharacteristic tested using Blackbox Testing. The test is performed by observing the security,

confidentiality of messages, and unauthorized access of the application.

Results of quality testing of Security subcharacteristic can be seen in

Table 4.57.

Table 4.57 WhatsApp Testing Results on Security Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Security Functions			
	a. Phone Number Verification System	Verify the phone number will be processed after the message dialog asking that the phone number entered by the user is correct	Phone number verification is successfully processed after the message dialog asking that the phone number entered by the user is correct	Success
	b. SMS verification system	If the SMS verification fails, then the popup will appear to inform that the verification code you entered is invalid to the verification code sent via SMS	SMS verification fails, if the verification code you entered is invalid to the verification code sent via SMS	Success
	c. System Settings	User privacy settings can be set as the user desires, such as: 1. Who can see my last seen 2. Who can see my profile photo 3. Who can see my status 4. Blocked contacts 5. Turn on / Turn off read receipts	User privacy settings successfully set as the user desires, such as: 1. Who can see my last seen 2. Who can see my profile photo 3. Who can see my status 4. Blocked contacts 5. Turn on / Turn off read receipts	Success
	d. Chat Settings System	Chat settings can be set as the user desires, such as: 1. Enter is send 2. Media auto-download 3. Font size 4. Wallpaper	Chat settings successfully set as the user desires, such as: 1. Enter is send 2. Media auto-download 3. Font size 4. Wallpaper 5. Email and Backup conversations	Success

No.	Test Case	Expected Results	Actual Results	Status
	e. Notifications Settings System	5. Email and Backup conversations 6. Delete, Clear, and Archive all conversations Notification settings can be set as the user desires, such as: 1. Conversation tones 2. Message notifications 3. Group notifications 4. Calls	6. Delete, Clear, and Archive all conversations Notification settings successfully set as the user desires, such as: 1. Conversation tones 2. Message notifications 3. Group notifications 4. Calls	Success
	f. Contacts Settings System	Contacts settings can be set as the user desires, such as: 1. Tell a friend 2. Pay for a friend 3. Show all contacts	Contact arrangement successfully set as the user desires, such as: 1. Tell a friend 2. Pay for a friend 3. Show all contacts	Success
2	Virus Detection			
	a. Security Scanner via TrustGo Application	WhatsApp application safely after the scan process	WhatsApp application declared safe after the scan process	Success
	b. Heartbleed Detector	Heartbleed undetectable virus that can steal information, although it is encrypted	WhatsApp application successfully undetectable virus Heartbleed	Success

Table 4.57 shows that all test cases, amounting to 8 have been successfully tested. From the results of the test case, it is known that the quality testing of Security subcharacteristic gain value with a score of 5. This is because 100% security system on WhatsApp application are available and work well.

In addition, the WhatsApp application has end-to-end encryption that hackers cannot know the content of the message sent by the user, even if requested by law enforcement officials though. However, end-to-end encryption only works on Android platform and only includes text messages. With these algorithms, increased privacy and security in a text message that is sent to the recipient of the message declared safe for use by the user. [22]

2. Accuracy

WhatsApp application testing on Accuracy subcharacteristic tested using Blackbox Testing. The test is performed by observing the output precision of the results obtained from a given user input on the application. Results of testing the quality of Accuracy subcharacteristic can be seen in Table 4.58.

Table 4.58 WhatsApp Testing Results on Accuracy Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Register SMS Verification System	Recipient of the message will receive a verification code via SMS from WhatsApp officially	Recipient of the message receive a verification code via SMS from WhatsApp officially	Success
2	Chatting a. Send message	The message will be sent to the recipient when the message was also the message contains: 1. Lowercase characters (a-z) 2. Uppercase characters (A-Z)	Message successfully delivered to the recipient when the message was also the message contains: 1. Lowercase characters (a-z) 2. Uppercase characters (A-Z)	Success

No.	Test Case	Expected Results	Actual Results	Status
	b. Attach Location	3. Figures (0-9) 4. Punctuation (~ `! @ # \$% ^ & * _ - + = { } [] \ ; " , . ◇ /?) Location coordinates sent to the recipient of the message will be in accordance with the position of the sender	3. Figures (0-9) 4. Punctuation (~ `! @ # \$% ^ & * _ - + = { } [] \ ; " , . ◇ /?) Location coordinates of messages successfully delivered to the recipient in accordance with the position of the sender	Success
	c. Conversation Email System	1. Chat is sent to the registered email will be received by the owner of the email 2. Chat is sent to the registered email will not be accepted by the owner of the email with the notification	1. Chat is sent to the registered email successfully received by the owner of the destination email 2. Chat is sent to the registered email received by the owner fails destination email with notification	Success
	d. Notifications Chat	1. Chat that is being sent will be marked with the icon of time 2. Chat that have been sent are marked with icon ✓ 3. Chat that have been accepted by the recipient of the message will be marked with icon ✓✓ 4. Chat that have been read by the recipient of the message will be marked with icon ✓✓ blue 5. Chat that is being written by the sender of the	1. Chat that is being sent successfully demonstrated time icon 2. Chat that have been sent successfully demonstrated icon ✓ 3. Chat that have been accepted by the recipient of the message failed to show icon ✓✓ 4. Chat that have been read by the recipient of the message failed to show icon ✓✓ blue 5. Chat that is being written by the sender of the	Success

No.	Test Case	Expected Results	Actual Results	Status
		message will be marked with the notice "is typing"	message successfully demonstrated notification "is typing"	
4	Contacts			
	Look for	When a search is done and the data is available, it appears in the message recipient's contact WhatsApp Contacts	When a search is done and the data is available, then the search is successful displays the message recipient's contact in BBM Contacts	Success

Table 4.58 shows that 11 test cases were tested successfully deliver the right and corresponding output results. From the results of the test case, it is known that the testing of the quality of Accuracy subcharacteristic scored with a score of 5. This is because 100% WhatsApp application has had the result of accurate output and run very well.

3. Suitability

WhatsApp application testing on Suitability subcharacteristic tested using Blackbox Testing. The test is performed by observing the results of each function conformity between the expected results with the results given significantly. Results of testing the quality of Suitability subcharacteristic can be seen in Table 4.59.

Table 4.59 WhatsApp Testing Results on Suitability Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Register			
	a. Press the 'Agree and Continue'	Agree with applicable regulations and enter the phone number verification page	Agree with applicable regulations and made it into a phone number verification page	Success

No.	Test Case	Expected Results	Actual Results	Status
	b. Select dropdown language to be used c. Find the desired language d. Find a language which is not listed e. Press the OK button on the Verify Phone Number f. Press the OK button on the message dialog verification phone number g. Press the 'Restore' in the Chat History h. Press 'Skip Restore' on the Chat History i. Press the 'Continue' at the Welcome to WhatsApp	Go to the language selection page Language appears sought It does not appear that sought language The message dialog to ensure that the phone number entered is correct, so the verification code can be sent via SMS Go to the page and the SMS Verification will send WhatsApp Code via SMS Chat history will not be lost and the chat will be refunded if there are previous chat activity Chat history will be lost and the previous chat activity will not be returned WhatsApp will be accessible to the user	Successful Go to language selection page Managed to find a desired language Cannot find the desired language Managed to show a message dialog to ensure that the phone number entered is correct, so the verification code can be sent via SMS Made it into the pages SMS Verification and managed to send WhatsApp Code via SMS Chat history is not lost and chat managed successfully restored if there is a previous chat activity Chat history successfully removed and chat activity not previously refunded WhatsApp successful accessible to users	Success Success Success Success Success Success Success Success
2	New Chat			
	a. Select the icon 'Start Chat' b. Select the message recipient's name in the contact WhatsApp	Go to the page select the contact Go to the chat page the recipient	Users successfully entered into the page select the contact for in-chat Users made it into the recipient chat page	Success Success

No.	Test Case	Expected Results	Actual Results	Status
	c. Find the contact recipient is in contact WhatsApp d. Find the contact recipient is not registered in the contact WhatsApp e. Select submenu 'Tell a friend' f. Select the desired media on the Pop Up Tell a Friend g. Select submenu 'Contacts' h. Select submenu 'Help'	Appears the message recipient's name is sought It does not appear that the message recipient's name sought A pop-up Tell a Friend to tell about WhatsApp Messenger on Android Media are selected will be notified about WhatsApp Messenger on Android Go to the Contact page which is the default application smartphone Go to the Help Contacts page and discusses the contacts list does not appear	Users managed to find the name of the message recipient Users are not able to find the name of the message recipient Managed to pop up Tell a Friend to tell about WhatsApp Messenger on Android The selected media managed to obtain notification of WhatsApp Messenger on Android Successful entry into the Contact page which is the default application smartphone Successful entry into the Help Contacts page and discusses the contacts list does not appear	Success Success Success Success Success
3	Chats			
	a. Select the tab 'Chats' b. Send message c. Send a message accompanied by emoticons d. Attach Picture, Contact, Location, and Audio	Go to the page Chats The message will be sent to the recipient when the message was also Emoticon will be sent to the recipient of the message Selected attachment will be sent to the recipient of the message	Made it into the pages Chats Users successfully send a message to the intended recipient User managed to send emoticons to the intended recipient User managed to send an attachment to the intended recipient	Success Success Success Success

No.	Test Case	Expected Results	Actual Results	Status
	e. Take photos to be sent to the recipient of the message	The captured images are sent to the recipients of the message	User managed to send the captured image to the message recipients	Success
	f. Send voice messages	Voice messages will be sent to the recipient of the message	Users successfully send voice messages to the intended recipient	Success
	g. Select submenu 'View Contact'	Go to the Contact page belonging to another user info	Made it into the pages of other users' Contact Info	Success
	h. Select submenu 'View in the address book' in the Contact Info	Go to the page of the user's contacts book selected	Made it into the book page of the user selected contacts	Success
	i. Select submenu 'Pay for [Contact Name]' in the Contact Info	Go to the page Pay for a friend	Made it into the pages Pay for a friend	Success
	j. Select submenu 'Media'	Go to page All media that have been submitted, both the message sender and recipient of the message	Made it into the pages All Media that has been sent, both the message sender and recipient of the message	Success
	k. Select submenu 'Search'	Messages are sought to be discovered if available on chat history and will not be found if not available	Messages were sought have been found if it's available on chat history and managed not to be found if it is not available	Success
	l. Select submenu 'Wallpaper'	Sign in to pop up Wallpaper to select desired wallpaper	Made it into the pop-up Wallpaper to select desired wallpaper	Success
	m. Select submenu 'More'	Block submenu appears, Clear Conversation, Conversation Email, and Add Shortcut	Successfully emerged submenu Block, Clear Conversation, Conversation Email, and Add Shortcut	Success
	n. Select submenu 'Block'	The selected contact is blocked and the message dialogue to	The selected contacts successfully diblock and the message	Success

No.	Test Case	Expected Results	Actual Results	Status
	o. Select submenu 'Unblock'	ensure the block activity to do Blocked contacts will be canceled	dialogue to ensure the block activity to do Blocked contacts successfully canceled	Success
	p. Select submenu 'Clear Conversation'	Overall chat messages between the recipient and the sender of the message will be deleted	Users successfully remove the entire chat messages between the receiver and sender of the message	Success
	q. Select submenu 'Email Conversation'	Overall chat messages between the recipient and the sender of the message will be sent via email	Users can send the entire chat via email	Success
	r. Select submenu 'Add Shortcut' or 'Add Conversation Shortcut'	Shortcut of messages between the message receiver and sender of the message will appear on the home smartphone	Shortcut of messages between recipients of the message and the message sender appears on the smartphone home	Success
	s. Select submenu 'Archive Conversation'	Chat to contact recipients of the selected message will be archived	Chat to contact recipients who have been successfully archived messages	Success
	t. Select the icon 'Message Info'	Go to the page Message Info and can see and read the information already sent	Made it into the Message Info page and can see and read the information already sent	Success
	u. Select the icon 'Delete Message'	The message will be deleted	Messages deleted successfully	Success
	v. Select the icon 'Copy Message'	Messages will be copied	Message successfully copied	Success
	w. Select the icon 'Forward Message'	The message will be forwarded to a designated contact	Message successfully forwarded to the destination contact	Success
	r. Select submenu 'New Broadcast'	Go to page New Broadcast	Made it into the pages of the New Broadcast	Success

No.	Test Case	Expected Results	Actual Results	Status
	s. Press the 'Create' in New Broadcast	The broadcast will be made after the user enters that members will be broadcast and the message will be sent to contacts who have become members	Broadcast successfully created after the user enters that members will be broadcast and the message is sent to contacts who have become members	Success
	t. Select submenu 'List Broadcast Info'	Go to the page Broadcast Info List	Successful entry into the List page Broadcast Info	Success
	u. Select the icon 'Add Contact' on the List Broadcast Info	Go to the contact page WhatsApp and the user can select a contact that will serve as members	Asuk managed to WhatsApp contact page and the user can select a contact that will serve as members	Success
	x. Select submenu 'Broadcast Media List'	Go to page All Media that has been sent by the sender of the message to members of the broadcast	Made it into the pages All Media that has been sent by the sender of the message to members of the broadcast	Success
	y. Press the icon 'Free Call'	Free call will be carried out and connect to the addressee	Users successfully perform free call and can connect to the addressee	Success
4	Groups			
	a. Select submenu 'New Group'	Go to page New Group	Made it into the pages of the New Group	Success
	b. Press the 'Next' and 'Create' in the New Group	Group successfully created after entering the group name and group members	User successfully created a group after entering the group name and group members	Success
	c. Select submenu 'Group Info'	Go to the page Group Info	Made it into the pages Group Info	Success
	d. Select submenu 'Group Media'	Go to the page of Group Media that has been sent by members of the group	Made it into Media Group pages that have been submitted by members of the group	Success
	e. Select submenu 'Mute'	Mute Group pop-up appears with a selection of which	Mute Group managed to pop up appears with a selection of	Success

No.	Test Case	Expected Results	Actual Results	Status
	f. Select submenu 'Cancel Mute' g. Select submenu 'Exit Group' h. Select submenu 'Delete Group'	can be selected by the user Mute group that has been done will be canceled Users will be out of the group have been The group will be deleted	which can be selected by the user Mute group that has been done successfully canceled Users made it out of the group have been Users successfully delete the group to be deleted	Success Success Success
5	Contacts			
	a. Select the tab 'Contacts' b. Select the icon 'Add Contact' c. Select submenu 'Refresh'	Go to the page Contacts Sign in to add contact page belongs smartphones WhatsApp Contacts will refresh and display a notification that the contact has been updated	Users made it into the pages Contacts Successful entry into the Add Contact page-owned smartphones WhatsApp contacts managed to refresh and display a notification that the contact has been updated	Success Success Success
6	Calls			
	a. Select the tab 'Calls' b. Select the icon 'Add Calls' c. Select an existing contact in the yard Calls d. Select the icon 'History Calls' e. Select the icon 'Delete Calls' f. Select submenu 'Clear Call Log'	Go to the page Calls Users select a contact, so it will contact the contact The selected contact will immediately call that contact Appears detail incoming or outgoing call that has been done History Calls will be removed Overall call log will be deleted	Users made it into the pages Calls Users select a contact, so managed to call that contact The selected contacts managed to call that contact Successfully emerged detail incoming or outgoing call that has been done History Calls successfully removed Overall call log successfully removed	Success Success Success Success Success
7	Status			
	a. Select submenu 'Status'	Go to the Status page that contains	Managed to get to the page that contains the	Success

No.	Test Case	Expected Results	Actual Results	Status
	i. Select submenu 'Profile'	Go to the Profile page	Made it into the Profile page	Success
	j. Select the icon 'Edit Profile Photo' and 'Edit Profile Name'	Profile Photo and Profile Name will be updated	Profile Photo and Profile Name successfully updated	Success
	k. Select submenu 'Account'	Go to the Account page	Made it into the pages Account	Success
	l. Select submenu 'Privacy' on Account	Go to the Privacy page and can arrange last seen, profile photo, status, blocked contacts, and read receipts	Made it into the pages Privacy and managed to organize last seen, profile photo, status, blocked contacts, and read receipts	Success
	m. Select submenu 'Payment Info' on Account	Go to the Payment page which displays info phone number, service expiration, and purchase extension	Payment made it into the page that displays info phone number, service expiration, and purchase extension	Success
	n. Select submenu 'Change Number' on the Account or the 'Want to change number instead?', Then press 'Next'	Go to the page Change Number and can replace the new phone number after the 'Done' is pressed	Made it into the pages Change Number and successfully replace the new phone number after the 'Done' is pressed	Success
	o. Select submenu 'Delete My Account' on Account	Go to the page Delete My Account	Managed to get to a page Delete My Account	Success
	p. Select the 'Delete My Account'	WhatsApp user accounts will be deleted after entering the country and telephone number	WhatsApp user account successfully removed after entering the country and telephone number	Success
	q. Select submenu "Network Usage" in the Account	Go to the page Network Usage and inform about the use of network WhatsApp has been done	Made it into the pages Network Usage and inform about the use of network WhatsApp has been done	Success

No.	Test Case	Expected Results	Actual Results	Status
	r. Select submenu 'Chat Settings' s. Select submenu 'Notifications' t. Select submenu 'Contacts'	Chat Go to the Settings page and can set the enter key, auto-downloaded media, and font size Go to the Notifications page and can organize conversations tones, message notifications, group notifications, and calls Go to the Contacts page and can manage the entire display contacts	Made it into the Chat settings page and can set the enter key, auto-downloaded media, and font size Notifications made it into the pages and can manage conversation tones, message notifications, group notifications, and calls Contacts made it into the pages and can manage the entire contact	Success Success Success

Table 4.59 shows that the entire *test case* which amounts to 87 successfully tested. From the results of the test case, it is known that the testing of the quality of Suitability subcharacteristic gain value with a score of 5. This is because 100% functionality on WhatsApp application has been running very well when users access the application.

4. Functionality Compliance

WhatsApp application testing on Functionality Compliance subcharacteristic tested using Guttman Scale. The test is performed by measuring the availability of existing functionality in standard applications WhatsApp as instant messenger applications. Results of testing the quality of Functionality Compliance subcharacteristic can be seen in Table 4.60.

Table 4.60 WhatsApp Testing Results on Functionality Compliance

No.	Statement	Answer (Yes / No)
1	WhatsApp application has the functionality to exchange text messages.	Yes
2	WhatsApp application has the functionality to exchange picture messages.	Yes
3	WhatsApp application has the functionality to exchange voice messages.	Yes
4	WhatsApp application has the functionality to exchange video messages.	Yes
5	WhatsApp application has the functionality to call through the Internet.	Yes

Table 4.60 shows that the five functionality standard that must be owned by the WhatsApp application as instant messenger applications have been met. From these results it can be seen that the quality testing of Functionality Compliance subcharacteristic scored with a score of 5. This indicates that the WhatsApp application has a standard instant messenger applications are excellent for use by the user.

5. Interoperability

WhatsApp application testing on Interoperability subcharacteristic tested using Blackbox Testing. The test is performed by observing the interaction between the existing functionality in the WhatsApp application with other systems that are outside the software. Results of testing the quality of Interoperability subcharacteristic can be seen in Table 4.61.

Table 4.61 WhatsApp Testing Results on Interoperability Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Chatting			
	a. Attach or Add Picture Gallery in smartphone	The overall picture in the Gallery will appear, so the user can select the desired image	The overall picture in the Gallery managed to emerge, so that the user can select the desired image	Success
	b. See map feature with maps application	Location coordinates sent by the sender of the message will be seen by the message recipient using the maps app, like GMaps or Waze	Location coordinates sent by the sender of the message recipient views the message by using the maps app, like GMaps or Waze	Success
	c. Email Conversation with email applications, chat, and cloud computing	Overall chat will be sent via e-mail applications, chat, and cloud computing, such as Gmail, Mail (the default application on the smartphone), Drive, and Skype	Overall chat successfully sent via email applications, chat, and cloud computing, such as Gmail, Mail (the default application on the smartphone), Drive, and Skype	Success
	d. Chatting with camera	Filming will be obtained from the camera (application default)	Filming was successfully obtained from the camera (application default)	Success
2	Contacts			
	a. Add Contact by Phone Contact (application default)	Contact book will be added to fill the existing data on the Contact Phone	Contact books is successfully added to fill the existing data on the Contact Phone	Success
	b. Invite with SMS applications	Contact invitation will be sent to other users via SMS applications	Contact invitation successfully delivered to other users through SMS applications	Success
3	Profile			
	Share Profile Photo by media	Photo belongs to the user's profile will be shared to media that can be selected, such as Bluetooth, Mail, Messaging, Notes, Facebook, WhatsApp, LINE, and so on	Photo belongs to the user's profile to successfully shared media to choose from, such as Bluetooth, Mail, Messaging, Notes, Facebook, WhatsApp, LINE, and so on	Success

Table 4.61 shows that the WhatsApp application has had to do with the interaction 7 systems that are outside the software. From these results it can be seen that the quality testing of Interoperability subcharacteristic gain value with a score of 5. This indicates that the WhatsApp application has good interoperability.

4.6.2 Testing of Reliability Characteristics

WhatsApp application quality on Android-based are tested on Reliability characteristic consists of four subcharacteristic to be assessed. Fourth subcharacteristic include Maturity, Fault Tolerance, Reliability Compliance, and Recoverability. Reliability characteristics testing against each subcharacteristic are as follows:

1. Maturity

WhatsApp application testing on Maturity subcharacteristic tested using Blackbox Testing. The test is performed by observing the frequency of failure can be avoided due to a software error. Results of testing the quality of Maturity subcharacteristic can be seen in Table 4.62.

Table 4.62 WhatsApp Testing Results on Maturity Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Send a message to the various characters and emoticons to a message recipient 100 times in the same time	The message will be sent as much as 100 times to a recipient of the message in the same time	The message is sent as many as 100 times to a recipient of the message in the same time	Success
2	Send a message to the various characters and emoticons to 100	The message will be sent to 100 recipients in the same time	The message is sent to 100 recipients in the same time	Success

No.	Test Case	Expected Results	Actual Results	Status
	recipients in the same time			
3	Send Broadcast Message to 100 recipients in the same time	Broadcast Message will be sent to 100 recipients in the same time	Broadcast Message successfully sent to 100 recipients in the same time	Success

Table 4.62 indicates that all test cases totaling 3 successfully tested. From the results of the test case, it is known that the testing of the quality of Maturity subcharacteristic scored with a score of 5. This is because 100% messages function on WhatsApp application have been able to avoid failure with excellent frequency due to the application error.

2. Fault Tolerance

WhatsApp application testing on Fault Tolerance subcharacteristic tested using the method BlacBox Testing. The test is performed by observing the WhatsApp application capabilities in maintaining performance by providing fault tolerance in the event of a system fault or human error. Results of testing the quality of Fault Tolerance subcharacteristic can be seen in Table 4.63.

Table 4.63 WhatsApp Testing Results on Fault Tolerance Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Register Create an account by entering a phone number that does not match by more than 10 times	Account will fail to be made if the phone number is not appropriate and the recipient will not receive the verification code from the WhatsApp	Account created failed because the phone numbers do not match and the recipient will not receive the verification code from the WhatsApp	Success

Table 4.63 shows the entire test case was successfully tested. From the results of the test case, it is known that the testing of the quality of Fault Tolerance subcharacteristic gain value with a score of 5. This is because 100% WhatsApp application can provide with excellent fault tolerance in the event of a system error or a user made a mistake on the application.

3. Reliability Compliance

WhatsApp application testing on Reliability Compliance subcharacteristic tested using Guttman Scale. The test is performed by measuring reliability that of the standard application WhatsApp as instant messenger applications. Results of testing the quality of Reliability Compliance subcharacteristic can be seen in Table 4.64.

Table 4.64 WhatsApp Testing Results on Reliability Compliance

No.	Statement	Answer (Yes / No)
1	WhatsApp applications have reliability in providing fault tolerance more than 60% chance	Yes
2	WhatsApp application has the reliability in avoiding more than 60% frequency of message delivery failure	Yes
3	WhatsApp application has the reliability in continuing its work back and restore user data when it occurs more than 2 errors in the system or network connection	Yes

Table 4.64 shows that three reliability standards that should be owned by the WhatsApp application as instant messenger applications have been met. WhatsApp application is able to provide fault tolerance by 100%, 100% avoid malfunction messaging, and continuing throughout his job back and recover all the user data when a system error occurs. From these

results it can be seen that the quality testing of Reliability Compliance subcharacteristic gain value with a score of 4. This indicates that the WhatsApp application have had instant messenger application reliability standards suitable for use by users.

4. Recoverability

WhatsApp application testing on Recoverability subcharacteristic is tested by using the method Blackbox Testing. The test is performed by observing the WhatsApp application capabilities in continuing its work back and restore user data in the event of an error in the system software and network connections. Results of testing the quality of Recoverability subcharacteristic can be seen in Table 4.65.

Table 4.65 WhatsApp Testing Results on Recoverability Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Send a message when the sender or recipient of the message was no network	The message has not been sent, but will go into the server to be executed when the network is available	The message has not been sent, but has entered into the server to be executed when the network is available	Success
2	While the message is being typed, there is an incoming call	The message being typed will not be lost	The message being typed managed not lost, so the user can continue writing the message	Success
3	While the message is being typed, the user switches to another application to minimize the WhatsApp application	The message being typed will not be lost	The message being typed managed not lost, so the user can continue writing the message	Success
4	While the message is being typed, the user out of the application	The message being typed will not be lost and will be stored on the chat between the	The message being typed managed not lost and already stored in the chat between the sender and	Success

No.	Test Case	Expected Results	Actual Results	Status
		sender and receiver of the message	receiver of the message	
5	While the message is being typed, the smartphone experience restart or shutdown	The message being typed will not be lost and will be stored on the chat between the sender and receiver of the message	The message being typed managed not lost and already stored in the chat between the sender and receiver of the message	Success

Table 4.65 shows that the entire test case was successfully tested. From the results of the test case, it is known that the testing of the quality of Recoverability subcharacteristic gain value with a score of 5. This is because the recovery function on the WhatsApp application has been able to continue its work back and restore user data with very well when system errors occur five or network connection.

4.6.3 Testing of Characteristics Efficiency

WhatsApp application quality on Android-based are tested on Efficiency characteristic consists of three subcharacteristic to be assessed. Third subcharacteristic include Time Behaviour, Resource Utilization, and Efficiency Compliance. Efficiency characteristics testing against each subcharacteristic are as follows:

1. Time Behaviour

WhatsApp application testing on Time Behaviour subcharacteristic tested using Blackbox Testing. The test is performed by measuring the speed of WhatsApp application under 3K/s in response and processing time when

carrying out its functions. The speed measurement is done using a stopwatch application. Results of testing the quality of Time Behaviour subcharacteristic can be seen in Table 4.66.

Table 4.66 WhatsApp Testing Results on Time Behaviour Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Send a text message with the character: a. Lowercase (a-z) b. Capital letters (A-Z) c. Figures (0-9) d. Punctuation mark e. Emoticon	Response and processing time on a short message with these characters will spend a maximum of 3 milliseconds	Short messages with these characters manage to spend time during the 1765 millisecond	Success
2	Send normal message with the character: a. Lowercase (a-z) b. Capital letters (A-Z) c. Figures (0-9) d. Punctuation mark e. Emoticon	Response and processing time on a short message with these characters will spend a maximum of 4 milliseconds	Normal message delivery with these characters manage to spend time during the 2137 millisecond	Success
3	Send a message length character: a. Lowercase (a-z) b. Capital letters (A-Z) c. Figures (0-9) d. Punctuation mark e. Emoticon	Response and processing time on a short message with these characters will spend a maximum of 5 milliseconds	Length of message delivery with these characters manage to spend time during the 2786 millisecond	Success

Table 4.66 shows that WhatsApp application to have the response and processing time at 1,765 milliseconds for a short message, the message is normal during 2137 milliseconds, and long messages during 2786 milliseconds. From these results it can be seen that the quality testing of Time Behaviour subcharacteristic gain value with a score of 3. This indicates the WhatsApp application have a response and processing time is quite good.

2. Resource Utilization

WhatsApp applications testing on Resource Utilization subcharacteristic tested using Blackbox Testing. The test is performed by observing the utilization of available resources WhatsApp applications when carrying out its functions. Results of testing the quality of Resource Utilization subcharacteristic can be seen in Table 4.67.

Table 4.67 WhatsApp Testing Results on Resource Utilization

No.	Test Case	Expected Results	Actual Results	Status
1	Check the RAM storage in Settings Smartphone	The maximum amount of RAM that is used when running the application function is 60 MB	When running an application function, RAM used successfully use a size of 56 MB	Success
2	Check Memory Settings application on Smartphone	The maximum amount of memory that is used when running the application functionality is 65 MB	When running an application function, Memory used successfully use the size of 58.31 MB	Success

Table 4.67 shows that WhatsApp application spending RAM storage resource by 56 MB and Memory at 58.31 MB. From these results it can be seen that the quality testing of Resource Utilization subcharacteristic gain value with a score of 3. This indicates WhatsApp application have sufficient resources consumption both when running the application functionality.

3. Efficiency Compliance

WhatsApp application testing on Efficiency Compliance subcharacteristic tested using Guttman Scale. The test is performed by

measuring the efficiency of existing on WhatsApp application as a standard instant messenger applications. Results of testing the quality of Efficiency Compliance subcharacteristic can be seen in Table 4.68.

Table 4.68 WhatsApp Testing Results on Efficiency Compliance

No.	Statement	Answer (Yes / No)
1	WhatsApp application has an efficiency in the exchange of text messages with exceeding 1,224 characters exist on SMS	Yes
2	WhatsApp applications have response and efficiency in delivering maximum processing time of 2 milliseconds on short messages (<80 characters)	Yes
3	WhatsApp applications have response and efficiency in delivering maximum processing time of 2.5 milliseconds at normal messages (81-160 characters)	Yes
4	WhatsApp applications have response and efficiency in delivering maximum processing time of 3 milliseconds on message length (> 160 characters)	Yes
5	WhatsApp application has a maximum efficiency in storage RAM 60 MB	Yes
6	WhatsApp application has a maximum efficiency in storage memory 65 MB	Yes

Table 4.68 shows that six efficiency standards that must be owned by the WhatsApp application as instant messenger applications have been met. WhatsApp able to load up to 2,000 characters of text messages, send short messages during the 1.765 millisecond, send normal messages during 2.137 milliseconds, send a long message for 2.786 milliseconds, spent 56 MB RAM for storage, and using 58.31 MB for memory storage applications. From these results it can be seen that the quality testing of Efficiency Compliance subcharacteristic scored with a score of 5. This indicates that the WhatsApp application has had a very good efficiency standards to be used by the user.

4.6.4 Testing of Usability Characteristics

WhatsApp application quality on Android-based are tested on Usability characteristic consists of five subcharacteristic to be assessed. Fifth subcharacteristic include Operability, Learnability, Understandability, Attractiveness, and Usability Compliance. Usability characteristics testing against each subcharacteristic conducted by questionnaire J.R Lewis by the number of respondents as many as 204 respondents. Results of the questionnaire processing of existing subcharacteristic on Usability characteristics can be seen in Table 4.69.

Table 4.69 WhatsApp Testing Results on Usability Characteristics

No.	Subcharacteristic	The Most Answers	Percentage Feasibility
1	Operability	Agree	45.47%
2	Learnability	Agree	49.02%
3	Understandability	Agree	46.57%
4	Attractiveness	Agree	50%
5	Usability Compliance	Agree	45.26%

Table 4.69 shows that 45.47% of respondents agree Operability provide user convenience in operating applications, 49.02% of respondents agreed Learnability aspect provides convenience in studying the application, 46.57% of respondents agree Understandability aspect provide user convenience in understanding the application, 50% of respondents agreed aspects of Attractiveness provide power attraction for users, as well as 45.26% of respondents agree Usability Compliance aspects complies with the standards instant messenger applications. Based on indicators that have been determined and the feasibility percentage obtained, it can be seen that the quality testing of:

1. Operability Subcharacteristic quite good with a score of 4.
2. Learnability Subcharacteristic quite good with a score of 4.
3. Understandability Subcharacteristic quite good with a score of 4.
4. Attractiveness Subcharacteristic quite good with a score of 4.
5. Usability Compliance Subcharacteristic quite good with a score of 4.

4.6.5 Testing of Portability Characteristics

WhatsApp application quality on Android-based are tested on Portability characteristic consists of five subcharacteristic to be assessed. Fifth subcharacteristic include Installability, Adaptability, Portability Compliance, Replaceability, and Coexistence. Portability characteristics testing against each subcharacteristic are as follows:

1. Installability

WhatsApp application testing on Installability subcharacteristic tested using Guttman Scale. The test is performed by observing the WhatsApp application capabilities during the installation on different environments. Environmental question is the Android operating system version used by the 204 respondents with various smartphone screen size of <5 inch. Results of testing the quality of Installability subcharacteristic can be seen in Table 4.70.

Table 4.70 WhatsApp Testing Results on Installability Aspect

No.	Statement	Answer (Yes / No)
1	The installation process successfully run well on the operating system Android 2.3 - 2.3.7 Gingerbread smartphone screen size of <5 inch.	Yes
2	The installation process successfully run well on the operating system Android 4.1 - Jelly Bean 4.3 on a smartphone screen size of <5 inch.	Yes
3	The installation process successfully run well on the operating system Android 4.0 - 4.0.4 Ice Cream Sandwich on the smartphone screen size of <5 inch.	Yes
4	The installation process successfully run well on the operating system Android 4.4 KitKat on the smartphone screen size of <5 inch.	Yes
5	The installation process successfully run well on the operating system Android 5.0 smartphone screen size Lollipop at <5 inch.	Yes

Table 4.67 indicates that the installation process on WhatsApp application successful runs fine on the fifth Android operating system, namely Gingerbread, Jelly Bean, Ice Cream Sandwich, KitKat, and Lollipop. From these results it can be seen that the quality testing of Installability subcharacteristic gain value with a score of 5. This indicates WhatsApp application has been able to perform the installation process very well.

2. Adaptability

WhatsApp application testing on Adaptability subcharacteristic tested using Guttman Scale. The test is performed by observing the WhatsApp application capabilities in adapting to the different environments. Environmental question is the Android operating system version used by the 204 respondents with various smartphone screen size of <5 inch. Results of testing the quality of Adaptability subcharacteristic can be seen in Table 4.71.

Table 4.71 WhatsApp Testing Results on Adaptability Aspect

No.	Statement	Answer (Yes / No)
1	All functions run well on the operating system Android 2.3 - 2.3.7 Gingerbread smartphone screen size of <5 inch.	Yes
2	All functions run well on the operating system Android 4.1 - Jelly Bean 4.3 on a smartphone screen size of <5 inch.	Yes
3	All functions run well on the operating system Android 4.0 - 4.0.4 Ice Cream Sandwich on the smartphone screen size of <5 inch.	Yes
4	All functions run properly on Android 4.4 KitKat operating system on a smartphone screen size of <5 inch.	Yes
5	All functions run properly on Android 5.0 operating system Lollipop in the smartphone screen size of <5 inch.	Yes

Table 4.71 shows that the function of the WhatsApp application successfully run well on the fifth Android operating system, namely Gingerbread, Jelly Bean, Ice Cream Sandwich, KitKat, and Lollipop. From these results it can be seen that the quality testing of Adaptability subcharacteristic gain value with a score of 5. This indicates WhatsApp application has been able to adapt very well.

3. Portability Compliance

WhatsApp application testing on Portability Compliance subcharacteristic tested using Guttman Scale. The test is performed by measuring the availability of portability that of the standard application WhatsApp as instant messenger applications. Results of testing the quality of Portability Compliance subcharacteristic can be seen in Table 4.72.

Table 4.72 WhatsApp Testing Results on Portability Compliance Aspect

No.	Statement	Answer (Yes / No)
1	WhatsApp has portability to applications running on the smartphone screen size of <5 inch	Yes
2	WhatsApp has the portability of applications to run on the fifth Android operating system (Gingerbread, Jelly Bean, Ice Cream Sandwich, KitKat, and Lollipop)	Yes
3	WhatsApp has the portability of applications to install applications on the Android operating system fifth without having to change the identity of the operating system or previous smartphone	Yes
4	WhatsApp application has the portability of more than 60% to coexist with shared resources on other software in the environment	Yes
5	WhatsApp has the portability of applications to replace more than 3 software similar	Yes

Table 4.72 shows that five portability standards that must be owned by the WhatsApp application as instant messenger applications have been met. WhatsApp application is able to run and install applications on the smartphone screen size of <5 inch Android Gingerbread operating system, Jelly Bean, Ice Cream Sandwich, KitKat, and Lollipop. In addition, this application is also able to co-exist with other software with a percentage of 75% and capable of replacing eight similar software. From these results it can be seen that the quality testing of Portability Compliance subcharacteristic scored with a score of 4. This indicates that the WhatsApp application have had good portability standards to be used by the user.

4. Replaceability

WhatsApp application testing on Replaceability subcharacteristic tested using Guttman scale. The test is performed by observing the functions of

the WhatsApp application in the instant messenger application replaces the similar contact with the terms contained in the user's friend also related applications. Results of testing the quality of Replaceability subcharacteristic can be seen in Table 4.73.

Table 4.73 WhatsApp Testing Results on Replaceability Aspect

No.	Statement	Answer (Yes / No)
1.	Multimedia message (text, images, sound, video), emoticons, free call / voice calls, as well as the group chat on WhatsApp application can replace the existing features in the application: a. BlackBerry Messenger (BBM) b. LINE Messenger c. WeChat d. KakaoTalk e. Hangouts by Google f. Yahoo Messenger g. Facebook Messenger h. Skype	Yes Yes Yes Yes Yes Yes Yes Yes Yes

Table 4.70 shows that the WhatsApp application can replace the existing features in eight instant messenger application that is similar. Features in BBM, Messenger LINE, WeChat, KakaoTalk, Hangouts by Google, Yahoo Messenger, Facebook Messenger, and Skype features include multimedia messaging (text, images, sound, video), emoticons, free call or a voice call, and group chat. From these results it can be seen that the quality testing of Replaceability subcharacteristic gain value with a score of 5. This indicates WhatsApp application capable of acting as an instant messenger application that can replace similar software very well.

5. Coexistence

WhatsApp application testing on Coexistence subcharacteristic tested using Blackbox Testing. The test is performed by observing the WhatsApp application capabilities while side by side with other software in the environment by sharing resources. Results of testing the quality of Coexistence subcharacteristic can be seen in Table 4.74.

Table 4.74 WhatsApp Testing Results on Coexistence Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Chatting			
	a. Attach or Add Picture Gallery in smartphone	RAM usage in the gallery will be allocated to the RAM usage on WhatsApp	RAM usage at the Gallery successfully allocated to RAM usage on WhatsApp	Success
	b. See map feature with maps application, which GMaps	RAM usage on GMaps will be allocated to the RAM usage on WhatsApp	RAM usage on GMaps successfully allocated to RAM usage on WhatsApp	Success
	c. See map feature with maps application, which Waze	RAM usage on Waze will be allocated to the RAM usage on WhatsApp	RAM usage on Waze fail allocated to RAM usage on WhatsApp	Failed
	d. Email Conversation with the email application, namely Gmail and Mail (the default application)	RAM usage on Gmail and Mail will be allocated to the RAM usage on WhatsApp	RAM usage on Gmail and Mail successfully allocated to RAM usage on WhatsApp	Success
	e. Email Conversation with the chat application, namely Skype	RAM usage on Skype will be allocated to the RAM usage on WhatsApp	RAM usage on Skype successfully allocated to RAM usage on WhatsApp	Success
	f. Email Conversation with cloud computing	RAM usage on the drive will be allocated to the	RAM usage on the drive successfully	Success

No.	Test Case	Expected Results	Actual Results	Status
	applications, the Drive g. Chatting with Camera	RAM usage on WhatsApp RAM usage on Camera will be allocated to the RAM usage on WhatsApp	allocated to RAM usage on WhatsApp RAM usage on Camera successfully allocated to the RAM on BBM consumption	Success
2	Contacts			
	a. Add Contact by Phone Contact (application default) b. Invite feature with SMS application, namely Messaging (application default)	RAM usage on the Contact will be allocated to the RAM usage on WhatsApp RAM usage in Messaging will be allocated to the RAM usage on WhatsApp	Contact RAM usage on successfully allocated to RAM usage on WhatsApp RAM usage on the Messaging failed allocated to RAM usage on WhatsApp	Success Failed
3	Profile			
	a. Change Profile Photo Gallery and Camera b. Share Profile Photo with media, such as Bluetooth, Cloud Album, Mail, Gmail, Notes, Dropbox, Drive, Skype	RAM usage on the Gallery and Camera will be allocated to the RAM usage on WhatsApp RAM usage on these media will be allocated to the RAM usage on WhatsApp	RAM usage on the Gallery and Camera successfully allocated to RAM usage on WhatsApp RAM usage on these media successfully allocated to the RAM usage on WhatsApp	Success Success
	c. Share Profile Photo with media, such as Messaging, BlackBerry Messenger, LINE, Facebook	RAM usage on these media will be allocated to the RAM usage on WhatsApp	RAM usage on these media failed to be allocated to the RAM usage on WhatsApp	Failed

Table 4.74 shows that 9 test case succeeded and 3 failed of 12 test cases were tested. From these results it can be seen that the quality testing of Coexistence subcharacteristic gain value with a score of 4. This is because

75% of WhatsApp applications able to co-exist with both among other software.

4.6.6 Testing of Maintainability Characteristics

WhatsApp application quality on Android-based are tested on Maintainability characteristic consists of two subcharacteristic to be assessed. Both subcharacteristic include Analyzability and Maintainability Compliance. Maintainability characteristics testing against each subcharacteristic are as follows:

1. Analyzability

WhatsApp application testing on subcharacteristic Analyzability tested using Blackbox Testing. Testing is done by observing the deficiency diagnosis or cause of failure in WhatsApp application. Results of testing the quality of Analyzability subcharacteristic can be seen in Table 4.75.

Table 4.75 WhatsApp Testing Results on Analyzability Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Register			
	Create an account by entering a phone number yet	The account will not be created and appear notice that the phone number required and necessary	Managed accounts are not created and appear notification that the phone number required and necessary	Success
2	Groups			
	Create Groups with not insert member	Group will fail to be made and a notification that the members should be included in advance	Group failed to be created and a notification that the members should be included in advance	Success

Table 4.75 shows that the entire test case was successfully tested. From the results of the test case, it is known that the testing of the quality of Analyzability subcharacteristic gain value with a score of 5. This is because 100% diagnosis deficiencies function or causes of failures in the WhatsApp application is available and run very well.

2. Maintainability Compliance

WhatsApp application testing on subcharacteristic Maintainability Compliance tested using Guttman Scale. The test is performed by measuring the standard maintenance associated WhatsApp application as instant messenger applications. Results of testing the quality of Maintainability Compliance subcharacteristic can be seen in Table 4.76.

Table 4.76 WhatsApp Testing Results on Maintainability Compliance

No.	Statement	Answer (Yes / No)
1	WhatsApp application has deficiencies or maintenance in diagnosing the cause of the failure of more than 60% when running a function	Yes
2	WhatsApp application service reports if users find errors or bugs	Yes
3	WhatsApp has a maintenance application in the development of applications continue updating	Yes

Table 4.76 shows that the three standards of maintenance that must be owned by the WhatsApp application as instant messenger applications have been met. WhatsApp applications 100% able to diagnose the cause of the failure, have service reports if users find the error or bug, as well as continue to provide updates on the development application. From these results it can be seen that the quality testing of Maintainability

Compliance subcharacteristic scored with a score of 4. This indicates that the WhatsApp application has a standard instant messenger application maintenance is good.

4.6.7 Quality Testing Results of WhatsApp Application

The value of the test results WhatsApp application quality on every characteristic has been obtained. This value is inserted into the variable c by calculating the total value of subcharacteristic as follows:

1. Functionality

- a. Security : $25.7\% * 5 = 25.7\%$
- b. Accuracy : $25.7\% * 5 = 25.7\%$
- c. Suitability : $20.6\% * 5 = 20.6\%$
- d. Compliance Functionality : $18.8\% * 5 = 18.8\%$
- e. Interoperability : $9.1\% * 5 = 9.1\%$

2. Reliability

- a. Maturity : $28.9\% * 5 = 28.9\%$
- b. Fault Tolerance : $28.9\% * 5 = 28.9\%$
- c. Reliability Compliance : $24.6\% * 4 = 19.7\%$
- d. Recoverability : $17.5\% * 5 = 17.5\%$

3. Efficiency

- a. Time Behaviour : 33.3% * 3 = 20%
- b. Resource Utilization : 33.3% * 3 = 20%
- c. Efficiency Compliance : 33.3% * 5 = 33.3%

4. Usability

- a. Operability : 29.6% * 4 = 23.7%
- b. Learnability : 21.7% * 4 = 17.4%
- c. Understandability : 18.5% * 4 = 14.8%
- d. Attractiveness : 17.5% * 4 = 14%
- e. Usability Compliance : 12.7% * 4 = 10.2%

5. Portability

- a. Installability : 33.6% * 5 = 33.6%
- b. Adaptability : 23.2% * 5 = 23.2%
- c. Portability Compliance : 18.7% * 4 = 15%
- d. Replaceability : 13.4% * 5 = 13.4%
- e. Coexistence : 11.1% * 4 = 8.9%

6. Maintainability

- a. Analyzability : 50% * 5 = 50%
- b. Maintainability : 50% * 4 = 40%

Of the total acquisition value of each subcharacteristic, the total value of factor analysis of each characteristic can be obtained by multiplying the value of each subcharacteristic grand total weight characteristics. Calculation of the total value of factor analysis of each characteristic in ISO 9126-1 Quality Model is as follows:

1. Functionality : $(25.7\% + 25.7\% + 20.6\% + 18.8\% + 9.1\%) * 45.3\% = 45.3\%$
2. Reliability : $(28.9\% + 28.9\% + 19.7\% + 17.5\%) * 24\% = 22.8\%$
3. Efficiency : $(20\% + 20\% + 33.3\%) * 11.9\% = 8.7\%$
4. Usability : $(23.7\% + 17.4\% + 14.8\% + 14\% + 10.2\%) * 9\% = 7.2\%$
5. Portability : $(33.6\% + 23.2\% + 15\% + 13.4\% + 8.9\%) * 6.2\% = 5.8\%$
6. Maintainability: $(50\% + 40\%) * 3.6\% = 3.2\%$

Results of calculation of the total value of each subcharacteristic and the total value of factor analysis of each characteristic described in Table 4.77. From the table, the grand total value of factor analysis on WhatsApp application can know the percentage of quality applications.

Table 4.77 Application Quality Testing Results WhatsApp

No	Characteristic	Weight	Subcharacteristic	Weight Value (w)(0-1)	Value	Total of Value Each Subcharacteristic	Total of Each Characteristic
		Max Value			(c)		
1	Functionality	45.3%	Security	25.7%	5	25.7%	45.3%
			Accuracy	25.7%	5	25.7%	
			Suitability	20.6%	5	20.6%	
			Functionality Compliance	18.8%	5	18.8%	
			Interoperability	9.1%	5	9.1%	
2	Reliability	24.0%	Maturity	28.9%	5	28.9%	22.8%
			Fault Tolerance	28.9%	5	28.9%	
			Reliability Compliance	24.6%	4	19.7%	
			Recoverability	17.5%	5	17.5%	
3	Efficiency	11.9%	Time Behaviour	33.3%	3	20.0%	8.7%
			Resource Utilization	33.3%	3	20.0%	
			Efficiency Compliance	33.3%	5	33.3%	
4	Usability	9.0%	Operability	29.6%	4	23.7%	7.2%
			Learnability	21.7%	4	17.4%	
			Understandability	18.5%	4	14.8%	
			Attractiveness	17.5%	4	14.0%	
			Usability Compliance	12.7%	4	10.2%	
5	Portability	6.2%	Installability	33.6%	5	33.6%	5.8%
			Adaptability	23.2%	5	23.2%	
			Portability Compliance	18.7%	4	15.0%	
			Replaceability	13.4%	5	13.4%	
			Coexistence	11.1%	4	8.9%	
6	Maintainability	3.6%	Analyzability	50.0%	5	50.0%	3.2%
			Maintainability Compliance	50.0%	4	40.0%	
	Jumlah	100%					93%

Table 4.77 shows that the quality of the WhatsApp application obtained was 93%. From the test results, Functionality characteristics obtain a percentage of 45.3%, amounting to 22.8% Reliability, Efficiency of 8.7%, amounting to 7.2% Usability, Portability amounted to 5.8%, and 3.2% Maintainability. Overall, the quality of

each characteristic WhatsApp application has been good with the majority of the value of the variable c is 4 and 5. However, there are still subcharacteristic which has a value of 3, so that needs to be addressed further. Subcharacteristic include Time Behaviour and Resource Utilization.

4.7 Testing of LINE Messenger Application

LINE is an instant messenger application that originated in Japan and was developed by Naver. Instant messenger application Nielsen third version of the most widely used will be tested quality based on standard ISO 9126-1 Quality Model. Tests performed on the LINE app on Android-based smartphone size <5 inch with the latest version, which is version 5.1.2.

4.7.1 Testing of Functionality Characteristics

LINE application quality on Android-based are tested on the Functionality characteristic consists of five subcharacteristic to be assessed. Fifth subcharacteristic include Security, Accuracy, Suitability, Functionality Compliance, and Interoperability. Functionality characteristics testing against each subcharacteristic are as follows:

1. Security

LINE application testing on Security subcharacteristic tested using Blackbox Testing. The test is performed by observing the security, confidentiality of messages, and unauthorized access of the application.

Results of testing the quality of Security subcharacteristic can be seen in Table 4.78.

Table 4.78 LINE Application Testing Results on Security Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Security Functions			
	a. Sign Up System	<p>Sign Up process will be successful if it meets the safety requirements where:</p> <ol style="list-style-type: none"> 1. The phone number entered is valid 2. Email must contain the @ symbol and the correct domain name 3. Passwords must have a length of characters between 6-20 with one capital letter (AZ), lowercase letters (az), numbers (0-9), as well as punctuation (^ _ # * + ? ! = . { } ~ ` &) 4. Given verification code via SMS must be processed within 30 minutes 	<p>Sign Up process is successfully carried out in compliance with the safety requirements where:</p> <ol style="list-style-type: none"> 1. The phone number entered is valid 2. Email has contain @ and domain, even though the domain is entered instead of the correct domain 3. Passwords have long containing characters between 6-20 with one uppercase, lowercase, numbers, and punctuation 4. Given verification code via SMS must be processed within 30 minutes 	<p>Success Failed Success Success</p>
	b. Log In System	If the Log In fails, the message dialog will appear to alert has occurred error and have to try again	Log In to fail if the username and password entered is not valid with LINE ID	Success
	c. Forgot Password System	a. Password will be processed and sent via email if	a. Password successfully processed and	Success

No.	Test Case	Expected Results	Actual Results	Status
		the user enters his email	sent via email after the user enters his email	
	d. Add Friends System	<ul style="list-style-type: none"> b. Password reset will only be processed within 1 hour after the password is sent via email c. Reset password will be expired and can not be processed after 1 hour dispatch password via email a. Plus a friend will be sent an invitation to the user through the scanning QR Code b. Invitations will be sent to other users if the destination is entered readable ID 	<ul style="list-style-type: none"> b. Password reset successfully processed within 1 hour after the password is sent via email c. Password reset successfully expired and can not be processed after 1 hour dispatch password via email a. Invite friends added successfully delivered to users after scanning the QR Code belonging to other users b. Invitation successfully delivered to the intended users other after entering the correct ID 	Success
	e. Settings System	User privacy settings can be set as the user desires, such as: 1. Passcode lock 2. Allow others to add by ID 3. Filter messages 4. Generate new QR Code	User privacy settings successfully set as the user desires, such as: 1. Passcode lock 2. Allow others to add by ID 3. Filter messages 4. Generate new QR Code	Success
	f. Chats and Voice Calls Settings System	Chat and voice call settings can be set as the user desires, such as: 1. Chat Wallpaper 2. Font Size	Settings chatting and voice calls successfully set as the user desires, such as: 1. Chat Wallpaper 2. Font Size	Success

No.	Test Case	Expected Results	Actual Results	Status
	<p>g. Notifications Settings System</p> <p>h. Group Settings System</p>	<p>3. Screen Options 4. Send with Return Key 5. Auto Resend 6. Photo Quality (sent) 7. Image Auto-Download 8. Sticker Previews 9. Display Suggestions 10. Receive Voice Calls 11. Clear Chat History 12. Delete files from the chat room</p> <p>Notification settings can be set as the user desires, such as: 1. Notifications 2. Mute 3. Tone 4. Sound 5. Vibrate 6. LED 7. Show Preview 8. Display when the Screen Pop-Ups ON or OFF 9. LINE Pay 10. Group Invitations 11. Timeline Notifications 12. Authorized or Unauthorized Apps</p> <p>Group settings can be set as the user desires, such as: 1. Show in group menu 2. Timeline notification 3. Invite by link or QR Code 4. Hidden group</p>	<p>3. Screen Options 4. Send with Return Key 5. Auto Resend 6. Photo Quality (sent) 7. Image Auto-Download 8. Sticker Previews 9. Display Suggestions 10. Receive Voice Calls 11. Clear Chat History 12. Delete files from the chat room</p> <p>Notification settings successfully set as the user desires, such as: 1. Notifications 2. Mute 3. Tone 4. Sound 5. Vibrate 6. LED 7. Show Preview 8. Display when the Screen Pop-Ups ON or OFF 9. LINE Pay 10. Group Invitations 11. Timeline Notifications 12. Authorized or Unauthorized Apps</p> <p>Group settings successfully organized as the user desires, such as: 1. Show in group menu 2. Timeline notification 3. Invite by link or QR Code 4. Hidden group</p>	Success Success

No.	Test Case	Expected Results	Actual Results	Status
	i. Timeline Settings System j. Friends Settings System	Friends settings can be set as the user desires, such as: 1. Who can see my activity on the Timeline and Home 2. Allow friends to see my new activity 3. Timeline hidden list Friends settings can be set as the user desires, such as: 1. Auto add friends 2. Allow others to add 3. Hidden users 4. Blocked users	Friends settings can be set as the user desires, such as: 1. Who can see my activity on the Timeline and Home 2. Allow friends to see my new activity 3. Timeline hidden list channel setting successful is set as the user desires, such as: 1. Auto add friends 2. Allow others to add 3. Hidden users 4. Blocked users	Success Success
2	Virus Detection			
	a. Security Scanner via TrustGo Application b. Heartbleed Detector	LINE application safely after the scan process Heartbleed undetectable virus that can steal information, although it is encrypted	LINE application declared safe after the scan process LINE application successfully undetectable virus Heartbleed	Success Success

Table 4.78 shows that 17 successful test case and 1 which failed on 18 test cases were tested. From the results of the test case, it is known that the testing of the quality of Security subcharacteristic gain value with a score of 5. This is because 94% of the security system on the LINE app has been available and run very well.

In addition, LINE applications has Chiper encryption contained in the list of cryptographic techniques used in e-government system chosen by the Japan CRYPTREC (Cryptography Research and Evaluation

Committees). Encryption can encrypt 100% of each user messages, both in 3G, 4G, or Wi-Fi, so that hackers cannot know the content of the message sent by the user. This encryption is the one recommended by the highest authority on Japanese encryption. With these algorithms, messages sent by users are safe to use. [23]

2. Accuracy

LINE application testing on Accuracy subcharacteristic tested using Blackbox Testing. The test is performed by observing the output precision of the results obtained from a given user input on the application. Results of testing the quality of Accuracy subcharacteristic can be seen in Table 4.79.

Table 4.79 LINE Testing Results on Accuracy Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Sign Up			
	SMS Verification System	At the time of the SMS verification, the LINE will send a verification code via SMS	Verification code successful sent to the user's phone number via SMS	Success
2	Log In			
	a. Login with Facebook	Login process will be successful after the user synchronizes his Facebook account by 4 digits behind his handheld telephone numbers	The process of synchronizing the user login is successful after his Facebook account by 4 digits behind his handheld telephone numbers	Success
	b. Forgot Password System	Reset password link will be emailed to the user and can only be used after 1 hour dispatch the password reset	Link password reset email successfully delivered to the user if registered email domain related and can only be used after	Success

No.	Test Case	Expected Results	Actual Results	Status
		1 hour dispatch the password reset		
2	Chatting			
	a. Send message	The message will be sent to the recipient when the message was also the message contains: 1. Lowercase characters (a-z) 2. Uppercase characters (A-Z) 3. Figures (0-9) 4. Punctuation (~`!@#\$%^&*_ - + = { } [] \ ; : , <> /?)	Message successfully delivered to the recipient when the message was also the message contains: 1. Lowercase characters (a-z) 2. Uppercase characters (A-Z) 3. Figures (0-9) and became the link if a minimum number entered is 7 digits 4. Punctuation (~`!@#\$%^&*_ - + = { } [] \ ; : , <> /?)	Success
	b. Send a message with Timer	The message recipient can read the message sent to him within the period specified by the sender of the message	Recipient of the message reads the message in the timeframe specified by the sender of the message	Success
	c. Attach Location	Location coordinates sent to the recipient of the message will be in accordance with the position of the sender	Location coordinates of messages successfully delivered to the recipient in accordance with the position of the sender	Success
	d. Notifications Chat	1. Chat that is being sent will be marked with icon ↗ 2. Chat that have been sent are tagged with the loss of icon ↗ 3. Chat that have been read by the recipient of the message will be marked with Read	1. Chat that is being sent successfully demonstrated icon ↗ 2. Chat that have been sent successfully marked by the loss of icon ↗ 3. Chat that have been read by the recipient of the message indicates posts Read	Success

No.	Test Case	Expected Results		Actual Results	Status
		4. Chat that is being written by the sender of the message will be marked with the notice "is writing a message ..."		4. Chat that is being written by the sender of the message successfully demonstrated notification "is writing a message ..."	Success
	e. Search Chats and Messages	<p>When a search is done and the data is available, it appears:</p> <ol style="list-style-type: none"> 1. The message recipient's contact page Chats 2. Messages sought 		<p>When a search is done and the data is available, then the search is successful showing:</p> <ol style="list-style-type: none"> 1. The message recipient's contact page Contacts 2. Messages sought 	Success
3	Groups				
	a. QR Code Update	QR Code belongs to the group will be updated	QR Code belongs to the group successfully updated	Success	Success
4	b. Update Invite Link	Link belongs to the group will be updated	Link-owned group successfully updated	Success	Success
	Friends				
	a. Invite Friend by SMS	Invitations are sent via SMS will be received by the recipient	Invitations are sent via SMS successfully received by the recipient	Success	Success
	b. Invite Friend by Email	Invitations were sent to the registered email will be received by the owner of the email	Invitations were sent to the registered email successfully received by the owner of the destination email	Success	Success
	c. QR Code Reader	QR Code is scanned will be directly read and written or delivered to the addressee	QR Code is scanned successfully read and written or delivered to the addressee	Success	Success
	d. Shake it!	Appears accounts belonging to other users in the area around the user	Successfully emerged accounts belonging to other users in the area around the user	Success	Success
	e. Search by ID	ID is entered by the user will appear if the	ID is entered by the user successfully emerge if the ID	Success	Success

No.	Test Case	Expected Results	Actual Results	Status
		ID contained in the database LINE	contained in the database LINE	

Table 4.79 shows that 18 test cases were tested successfully deliver the right and corresponding output results. From the results of the test case, it is known that the testing of the quality of Accuracy subcharacteristic scored with a score of 5. This is because 100% LINE application provides the output results are accurate and run very well.

3. Suitability

LINE application testing on Suitability subcharacteristic tested using Blackbox Testing. The test is performed by observing the results of each function conformity between the expected results with the results given significantly. Results of testing the quality of Suitability subcharacteristic can be seen in Table 4.80.

Table 4.80 LINE Testing Results on Suitability Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	<p>Sign Up</p> <p>a. Press the tab 'Sign up'</p> <p>b. Select dropdown language to be used</p> <p>c. Press the 'Next' on the Sign Up</p>	<p>Go to the page Sign Up</p> <p>Go to the language selection page and select the language you want to use</p> <p>The message dialog to ensure that the phone number entered is correct, so the verification code can be sent via SMS</p>	<p>Made it into the pages Sign Up</p> <p>Successful Go to the language selection page and successfully choose the language you want to use</p> <p>Managed to show a message dialog to ensure that the phone number entered is correct, so the verification code can be sent via SMS</p>	<p>Success</p> <p>Success</p> <p>Success</p>

No.	Test Case	Expected Results	Actual Results	Status
	d. Press the OK button on the popup verification code e. Press the 'Next' button when entering the verification code	Go to the page and the LINE Verification Code will send the code via SMS Data synchronization will be performed and the application will be accessible LINE	Made it into the pages and the Code Verification LINE will send the code via SMS Synchronization data has been carried out and successfully accessed LINE application	Success Success
2	Log In			
	a. Press the tab 'Log In'	Go to the page Log In	Made it into the pages Log In	Success
	b. Press 'OK' to enter the email address and password or appropriate	Sign In to fail and alert the user to fill in data back	Sign In User unsuccessful and must re-enter your email address and or password is not appropriate	Success
	c. Press the 'Sign In' by entering the email address or password does not match	Sign In to fail and tell the user to try again	Users do not succeed Sign In and have to try again	Success
	d. Press the 'Login with Facebook'	Login with Facebook will be successfully carried out	Login with Facebook successfully performed	Success
	e. Press the 'Next' button on Login with Facebook	Login will be successful after entering the 4 digit PIN behind the phone number	Login successfully carried out after entering the 4 digit PIN behind the phone number	Success
	f. Press the "Forget your password? "	Go to the Reset Password page and enter your email address	Users made it into the Reset Password page and enter your email address	Success
	g. Press the 'Not Registered'	Go to the page LINE User Login	Made it into the pages LINE User Login	Success
	h. Press the 'Verify Phone Number'	Go to the page Sign Up	Made it into the pages Sign Up	Success
3	New Chat			
	a. Select the icon 'Start Chat'	Go to the page select the contact	Users successfully entered into the page	Success

No.	Test Case	Expected Results	Actual Results	Status
	b. Choose a contact name in the message recipients LINE, then press the 'Chat' c. Find the contact recipient is in contact LINE d. Find the contact recipient is not registered in the contact LINE	Go to the chat page the recipient Appears the message recipient's name is sought It does not appear that the message recipient's name sought	select the contact for in-chat Users made it into the recipient chat page Users managed to find the name of the message recipient Users are not able to find the name of the message recipient	Success Success Success
4	Chatting			
	a. Send message b. Send a message accompanied by emoticons and or sticker c. Attach Photo, Video, Contact Info and Location d. Take photos to be sent to the recipient of the message e. Download the video to be sent to the recipient of the message f. Send voice messages g. Select the icon 'Snap Movie',	Message successfully delivered to the recipient when the message was also Emoticons and or sticker successfully delivered to the recipient of the message Selected attachment will be sent to the recipient of the message The captured images are sent to the recipients of the message Captured video will be sent to the recipient of the message Voice messages will be sent to the recipient of the message Heading into the application Snap	Users successfully send a message to the intended recipient User managed to send emoticons and or sticker to the intended recipient User managed to send an attachment to the intended recipient User managed to send the captured image to the message recipients User managed to send video to the recipient of the message Users successfully send voice messages to the intended recipient Managed to get to the application Snap	Success Success Success Success Success Success

No.	Test Case	Expected Results	Actual Results	Status
	'LINE camera', or 'ycon'	Movie / LINE Camera / ycon if already downloaded	Movie / LINE Camera / ycon if already downloaded	
	h. Select submenu 'Invite' and select a contact to be selected	Invitations will be sent to contacts who have chosen to join the chat together (multiperson chat)	Users successfully invite contacts who have chosen to join the chat together (multiperson chat)	Success
	i. Select submenu 'Notification Off'	Alert message to the intended recipient will be turned off	Alert message to the intended recipient successfully shut down	Success
	j. Select submenu 'Notification On'	Alert message to the intended recipient will be activated	Alert message to the intended recipient successfully activated	Success
	k. Select submenu 'Block'	The selected contact is blocked and display a notification that the user has the contact block	The selected contacts successfully diblock and emerging notification that the user has the contact block	Success
	l. Select submenu 'Unblock'	Blocked contacts will be canceled and a notification that the user has canceled the contact block on the	Blocked contacts successfully canceled and a notification that the user has canceled the contact block on the	Success
	m. Select submenu 'Edit Message'	Messages Delete button a popup appears, Forward, and Save to Post	Successfully emerged popup Messages Delete button, Forward, and Save to Post	Success
	n. Press the 'Delete Messages'	Users can choose which messages are deleted after pressing the Delete key	Users can choose which messages are deleted after pressing the Delete key	Success
	o. Press the 'Forward'	The message will be forwarded to a designated contact	Message successfully forwarded to the destination contact	Success
	p. Press the 'Save to Post'	The messages will be stored at the Post in the Social Network between	The message is stored at the Post in the album between the	Success

No.	Test Case	Expected Results	Actual Results	Status
	q. Select submenu 'Send a Gift'	the sender and the recipient	sender and the recipient	Success
	r. Select submenu 'Albums'	Go to the page Sticker Shop to choose sticker that will be sent to the recipient of the message	Made it into the Sticker Shop page to choose sticker that will be sent to the recipient of the message	Success
	s. Select submenu 'Photos'	Go to the Photos page has been sent, both the message sender and recipient of the message	The album made it into the pages between the sender and the recipient	Success
	t. Select submenu 'Chat Settings'	Chat Go to the Settings page and can arrange chat wallpaper, backup chat history, delete all chat records, create a shortcut for a chat or free calls, and report	Made it into the Chat settings page and can arrange chat wallpaper, backup chat history, delete all chat records, create a shortcut for a chat or free calls, and report	Success
	u. Press the 'Copy'	Messages will be copied	Users successfully copy a selected message	Success
	v. Select submenu 'Free Call'	Free call will be carried out and connect to the addressee	Users successfully perform free call and can connect to the addressee	Success
	w. Select submenu 'Video Call'	Video calls will be carried out and connect to the addressee	User managed video call and can connect to the addressee	Success
	x. Select submenu 'Hidden Chat'	Overall the message is hidden (encrypted)	Overall the message is hidden (encrypted)	Success
	y. Select submenu 'Timer'	Span of time reading messages that have	Span of time reading messages that have	Success

No.	Test Case	Expected Results	Actual Results	Status
	<p>z. Select submenu 'Ecryption Key'</p> <p>aa. Press the 'Archive'</p> <p>bb. Press the 'Remove'</p> <p>cc. Select the icon 'Search' in Chats</p>	<p>been processed, so that only the message recipient can read the message with the time span</p> <p>Go to the Encryption Key page that displays the encryption of the message sender ID and the receiver of the message</p> <p>Chat to contact recipients of the selected message will be archived</p> <p>Contacts in chat history will be lost</p> <p>Contacts in the yard Chats and message sought to be found if it's available on chat history and will not be found if not available</p>	<p>been successfully processed, so that only the message recipient can read the message with the time span</p> <p>Made it into the Encryption Key page that displays the encryption of the message sender ID and the receiver of the message</p> <p>Chat to contact recipients who have been successfully archived messages</p> <p>Contacts in the chat history managed to disappear</p> <p>Contacts in the yard Chats and messages are searchable have been found if it is available on chat history and will not be found if not available</p>	<p>Success</p> <p>Success</p> <p>Success</p> <p>Success</p>
5	Social Network			
	<p>a. Select the icon 'Social Network'</p> <p>b. Press the 'Post'</p> <p>c. Press the icon 'Write Post'</p> <p>d. Select submenu 'Edit Post'</p> <p>e. Select submenu 'Delete Post'</p>	<p>Go to the page Social Network</p> <p>Appear popup to ensure the activity of the division of posts and albums with selected contacts</p> <p>Post written to be sent</p> <p>Post has been written to be updated</p> <p>Post has been written to be removed</p>	<p>Made it into the pages Social Network</p> <p>Successfully emerged popup to ensure the distribution of posts and albums activity with a selected contact</p> <p>Post written successfully sent</p> <p>Post has been written successfully updated</p> <p>Post has been written successfully removed</p>	<p>Success</p> <p>Success</p> <p>Success</p> <p>Success</p> <p>Success</p>

No.	Test Case	Expected Results	Actual Results	Status
	f. Press the icon or the 'Create Album' g. Select the icon 'Settings' on Social Network	The album will be made after the photos have been Go to the Settings page and can regulate the activation of social networks in the group menu and timeline notification	Album successfully created after the photograph has been Successful entry into the Settings page and can regulate the activation of social networks in the group menu and timeline notification	Success Success
6	Timeline			
	a. Select the tab 'Timeline'	Go to the page Timeline	Users made it into the Timeline page	Success
	b. Select the icon 'Notifications'	Displays notifications from other users	Managed to display notifications from other users	Success
	c. Press the icon 'Settings'	Go to the page Timeline Notification and can manage all of the incoming notification, notification of activities like, comment, and share user posts	Made it into the Timeline page Notification and can manage all of the incoming notification, notification of activities like, comment, and share user posts	Success
	d. Press submenu 'Write'	Written status will be sent to the Timeline	Status written successfully sent to the Timeline	Success
	e. Press submenu 'Photo'	The selected photo will be sent to the Timeline	Photo is selected successfully sent to the Timeline	Success
	f. Press submenu 'Sticker'	The selected sticker will be sent to the Timeline	The selected sticker successfully sent to the Timeline	Success
	g. Give Timeline friend likes in activity or official account	Likes to be sent to a friend or official activity accounts Timeline	User managed to send a friend likes to Timeline activity or official account	Success
	h. You can comment on friend Timeline activity or official account	Comments will be sent to a friend or official activity accounts Timeline	User managed to send a comment to a friend or official accounts Timeline	Success

No.	Test Case	Expected Results	Actual Results	Status
	i. Press the 'Share on Timeline' in the option Share j. Press the 'To Chat' on the option Share k. Press the 'Hide from Timeline'	Share the post of Official Account activity related to the user timeline Share the post of Official Account activity related to the recipient that the message has been Post from a friend or Official Account activity will be hidden	User managed to share the post of Account Official activities related to the user timeline User managed to share the post of Account Official activities related to the recipient that the message has been Post of activity or Official Account friend successfully hidden	Success Success Success
7	Groups			
	a. Select the icon 'Groups'	Go to the page Groups	Users made it into the pages Groups	Success
	b. Press the 'Create a Group'	The group will be made, accompanied by members	User successfully created a group even though no members	Failed
	c. Press the icon 'Favorites'	The selected group will be contact in the Favorites category	Selected group managed to a contact in the Favorites category	Success
	d. Press the icon 'Unfavorites'	The selected group will be void a contact in the Favorites category	Selected group successfully canceled for a contact in the Favorites category	Success
	e. Select submenu 'Group Chat'	Go to the page of Group Chat	Users made it into the pages Group Chat	Success
	f. Submenu select 'Edit Group'	Go to the page Settings / Edit Group and can set the activation group in the group menu, timeline notification, invite by link and QR Code, and out of the group	Made it into the page Settings / Edit Group and can set the activation group in the group menu, timeline notification, invite by link and QR Code, and out of the group	Success
	g. Press the button 'Invite' or 'Add Members'	The new members will be added in the group that was created through the	Users successfully added a new member in the group through a QR Code, Invite Link,	Success

No.	Test Case	Expected Results	Actual Results	Status
	h. Press the tab 'QR Code'	QR Code, Invite Link, LINE Contact, Email, and Text Message	LINE Contact, Email, and Text Message	
	i. Press the 'Save to Album' on the tab QR Code	QR Code appeared owned group chosen	Successfully emerged QR Code belongs to the selected group	Success
	j. Press the 'Update QR Code' on the tab QR Code	QR Code will be stored in the album belongs to group related	QR Code successfully stored in the Album belonging to group related	Success
	k. Press the 'Copy Invite Links' on the tab Invite Link	QR Code related belonging group will be updated	QR Code related belonging group successfully updated	Success
	l. Press the 'Update Invite Links' on the tab Invite Link	Link group to be copied	Link group successfully copied	Success
	m. Press the tab 'Email'	Link related belonging group will be updated	Link related belonging group successfully updated	Success
	n. Press the tab 'Text Message'	Group invitation will be sent an email to other users targeted	Users group managed to send an invitation email to other users targeted	Success
	o. Press the button 'Group Details'	Group invitation will be sent to the intended recipient via SMS	Users group managed to send an invitation to the intended recipient via SMS	Success
	p. Press the 'Edit Members'	Displays detail grop members and pending members	Managed to display the details grop members and pending members	Suceess
	q. Select submenu 'Leave'	Members of the group will be updated if there is a member who is removed from the group	Members of the group successfully updated if there is a member who is removed from the group	Success
		The group will be deleted after pressing the 'Yes'	Users successfully delete the group to be deleted	Success

No.	Test Case	Expected Results	Actual Results	Status
8	Friends			
	a. Select the tab 'Friends'	Go to the Friends page which is contact LINE	Users successfully entered into the page Friends	Success
	b. Select the icon 'Add Friends'	Go to the page Add Friends and friends who are in the Friends list can be selected and will be added	Users made it into the pages Add Friends and friends who are in the Friends list can be selected and successfully added	Success
	c. Select submenu 'Invite' and press the button 'Invite friend by SMS'	The user's contact invitation will be sent to the intended recipient via SMS	Users successfully sent invitations to his contacts intended recipient via SMS	Success
	d. Select submenu 'Invite' and press the button 'Invite friend by email'	The user's contact invitation will be sent to the intended recipient	User managed to send his contact invitation email to the intended recipient	Success
	e. Select submenu 'Invite' and press the button 'Invite friend by Share'	The user's contact invitation will be distributed and delivered to the destination media	Users successfully distribute and transmit his invitation to contact the destination media	Success
	f. Select submenu 'QR Code'	Contact other users will be sent to the user's contacts through scan QR Code	Contact other users successfully sent to the user's contacts through another scan destination QR Code	Success
	g. Select submenu 'Shake it!'	Accounts belonging to other users will appear to be invited on the condition that users are around the area	Accounts belonging to other users successfully appears to be invited to the terms to be around the area user	Success
	h. Select submenu 'Search by ID'	Accounts belonging to other users will appear to be invited if the ID is valid	Accounts belonging to other users successfully appears to be invited if the ID is valid	Success
	i. Press the 'Block'	The selected contact will be blocked	Selected contacts successfully blocked	Success

No.	Test Case	Expected Results	Actual Results	Status
	j. Press the 'Unblock' k. Press the 'Hide' l. Press the 'Remove' m. Select submenu 'Edit Friends List' n. Select submenu 'Friends Settings'	Block the selected contact will be canceled The selected contact will be hidden The selected contacts in the Friends will be removed Go to the page Edit Friends List and can block or hide contacts that have been Go to the Settings page and can set the auto add friends, allow others to add, and manage friends that have been hidden and blocked	Block the selected contact successfully canceled Selected contacts successfully hidden Selected contacts in the Friends has been successfully removed Successful entry into the Edit Friends List and managed to block or hide contacts that have been Successful entry into the Settings page and successfully manage auto add friends, allow others to add, and manage friends that have been hidden and blocked	Success Success Success Success
9	More			
	a. Select the tab 'More' b. Press submenu 'Settings' c. Press submenu 'Profile' d. Edit Profile Photo	Go to the page More Go to the Settings page that displays settings My Info, Shops, Basic Settings, and Details Set the registers phone numbers, activation share profile photo, display name, status, user ID, activation add by ID, and QR Code Profile photo will be updated by taking a photograph, beauty selfie, or choose from the gallery	Users made it into the pages More Users made it into the Settings page that displays settings My Info, Shops, Basic Settings, and Details Users successfully set up registers phone numbers, activation share profile photo, display name, status, user ID, activation add by ID, and QR Code Profile Photo successfully updated to take photos, beauty selfie, or choose from the gallery	Success Success Success Success

No.	Test Case	Expected Results	Actual Results	Status
	e. Press 'Delete Photo'	Profile photo will be removed	Profile Photo successfully removed	Success
	f. Select submenu 'Home' in Profile	Go to the home page user profile	Successful entry into the home page of the user's profile	Success
	g. Select submenu 'Accounts'	Go to the Account page and be able to set up email account registration, link up, authorized apps, allow login, and devices	Users made it into the Account page and be able to set up email account registration, link up, authorized apps, allow login, and devices	Success
	h. Press the 'Delete My Account'	LINE user account will be deleted	LINE user account successfully removed	Success
	i. Select submenu 'Privacy'	Go to the Privacy page and can set a passcode lock, filter messages, receive friend requests, and generate QR Code	Users successful Go to the Privacy page and can set a passcode lock, filter messages, receive friend requests, and generate QR Code	Success
	j. Select submenu 'PIN'	Go to the page Set PIN	Made it into the pages Set PIN	Success
	k. Press the 'OK' on the Set PIN	The PIN will be configured after the user enters a 4-digit PIN	PIN successfully configured after the user enters a 4-digit PIN	Success
	l. Select submenu 'Coins'	Go to the page Coins and can arrange Coins Charge, Charge History, and Coin Usage History	Users Coins made it into the pages and can arrange Coins Charge, Charge History, and Coin Usage History	Success
	m. Select submenu 'Notifications'	Go to the Notifications page and can set notifications and customized settings	Users made it into the Notifications page and can set notifications and customized settings	Success
	n. Select submenu 'Chat and Voice Calls'	Go to page Chat and Voice Calls and can arrange Chats, Voice Calls, and Chat History	Users made it into the pages Chat and Voice Calls and can arrange Chats, Voice Calls, and Chat History	Success

No.	Test Case	Expected Results	Actual Results	Status
	o. Select submenu 'About LINE' p. Press the icon or the 'Help'	LINE version information appears on Messenger, terms of service, privacy policy and legal notices Go to the Help page	Information about the version of LINE Messenger, terms of service, privacy policy and legal notices successfully emerge Users made it into the pages Help	Success Success
10	Stickers Shop			
	a. Select submenu 'Sticker Shop' b. Press the tab 'TOP' c. Press the tab 'NEW' d. Press the tab 'FREE' e. Press the icon 'List Sticker' f. Press the icon 'Search Sticker' g. Press the icon 'Sticker Settings'	Go to the page Sticker Shop Sticker appears the most in demand Appears latest sticker Appears sticker that is not paid / free Appeared category of each sticker Sticker is sought will be found if there is the sticker listing Go to the page Stickers and can arrange sending stickers and stickers	Users successfully entered into the page Sticker Shop Sticker most desirable managed to emerge Latest Sticker successfully emerge Sticker is not a paid / free successfully emerge Categories of each sticker successfully emerge Sticker is sought have been found if the sticker found on the list Users made it into the pages Stickers and can arrange sending stickers and stickers	Success Success Success Success Success Success Success
11	Theme Shop			
	a. Select submenu 'Theme Shop' b. Select Theme free c. Select Theme paid	Go to the page Theme Shop Go to the page of the Theme Details are free and can download the theme Go to the page of the Theme Details are paid and can buy these themes	Users made it into the pages Theme Shop Users made it into the pages Theme Details are free and can download the theme Users made it into the pages Theme Details are paid and can buy these themes	Success Success Success

No.	Test Case	Expected Results	Actual Results	Status
	<p>d. Press the 'Apply Now' on the theme that has been downloaded / paid</p> <p>e. Press the 'Apply Later' on the theme that has been downloaded / paid</p> <p>f. Select the icon 'Theme Settings'</p>	<p>Theme will be the background of the user's application</p> <p>Theme will be postponed to serve as a background application users</p> <p>Go to the Theme Settings page and can manage themes</p>	<p>Theme managed to become a background application users</p> <p>Theme managed to put on hold to serve as a background application users</p> <p>Users made it into the Theme Settings page and can manage themes</p>	<p>Success</p> <p>Success</p> <p>Success</p>
11	Official Accounts			
	<p>a. Select submenu 'Official Accounts'</p> <p>b. Official name or ID Accounts</p> <p>c. Select submenu 'Add' on the Official Account Selected</p> <p>d. Select submenu 'Home' in the Official Account Selected</p>	<p>Go to the Official Accounts page to display the category New Official Accounts, Sports, Artists, Brands, Entertainment, Games, Shopping, Public Services, Books / Magazines, Media, and News / Tools</p> <p>Official Accounts name or ID will be found if there is the list of Official Accounts</p> <p>Official Account selected contacts will be added to the user</p> <p>Go to the home page Official Preferred Account</p>	<p>Users made it into the Official Accounts page by displaying the category New Official Accounts, Sports, Artists, Brands, Entertainment, Games, Shopping, Public Services, Books / Magazines, Media, and News / Tools</p> <p>Official Accounts name or ID was found if there is the list of Official Accounts</p> <p>Official Accounts that have been successfully added to the user's contacts</p> <p>Successful entry into the home page Official Preferred Account</p>	<p>Success</p> <p>Success</p> <p>Success</p> <p>Success</p>
12	LINE Pay			
	Select submenu 'LINE Pay'	Heading into the LINE app Pay	LINE application successfully headed to Pay	Success
13	Notices			
	Select submenu 'Notices'	Go to the page Notices and display notifications about LINE	Notices made it into the pages and displays notifications about LINE	Success

No.	Test Case	Expected Results	Actual Results	Status
14	LINE Apps			
	a. Select submenu 'LINE Apps' b. Press the icon 'Download'	Go to the page LINE Apps The selected LINE Apps downloaded	Made it into the pages LINE Apps LINE Apps Preferred successfully downloaded	Success Success
15	LINE Games			
	Select submenu 'LINE Games'	Go to the page and displays LINE Games games-games along its category	Made it into the pages and displays LINE Games games-games along its category	Success
16	Free Coins			
	Select submenu 'Free Coins'	Log into the page Free Coins and display coin history, notifications, terms of service, and receive Unable coins	Made it into the page Free Coins and display coin history, notifications, terms of service, and receive Unable coins	Success
17	Find Alumni			
	a. Select submenu 'Find Alumni'	Go to the page Find Alumni	Made it into the pages Find Alumni	Success
	b. Select submenu 'Add School'	Schools will be added after entering the country, education, school name and graduation year	School successfully added after entering the country, education level, school name and graduation year	Success
	c. Select submenu 'Alumni [School Name]'	Go to page Alumni [School Name] and display the alumni account has been verified	Users made it into the Alumni page [School Name] and display the alumni account has been verified	Success
	d. Edit Name and Username in Profile in List Alumni	Names and nicknames will be updated	Names and nicknames successfully updated	Success
	e. Press the 'Share on Facebook' in Alumni [School Name]	Alumni schools selected will be shared to Facebook	Alumni selected schools successfully shared to Facebook	Success
	f. Press the 'Share on Timeline' in Alumni [School Name]	Alumni schools selected will be shared to Timeline LINE	Alumni selected schools successfully shared to Timeline LINE	Success

No.	Test Case	Expected Results	Actual Results	Status
	g. Press the 'Report' on account of alumni who are considered not graduates of the school	A report will be sent to the LINE by selecting the reasons if the account is not the school alumni	Report successfully sent to the LINE by selecting the reasons if the account is not the school alumni	Success
	h. Press the 'Verify' on account of alumni who have not been verified	Alumni account will be verified and a member of the alumni of the school	Alumni account was successfully verified and became a member of the alumni of the school	Success
	i. Select the icon 'School Info'	Go to the page School Info	Made it into the pages School Info	Success
	j. Press the 'Leave This School'	Users will leave school alumni who have been	Users successfully leave school alumni who have been	Success

Table 4.80 shows that the 143 test cases succeed and 1 fails of 144 test cases tested. From the results of the test case, it is known that the testing of the quality of Suitability subcharacteristic gain value with a score of 5. This is because 99% of the functions on the LINE app has been running very well when users access the application.

4. Functionality Compliance

LINE application testing on Functionality Compliance subcharacteristic tested using Guttman Scale. The test is performed by measuring the availability of existing functionality in standard applications LINE as instant messenger applications. Results of testing the quality of Functionality Compliance subcharacteristic can be seen in Table 4.81.

Table 4.81 LINE Testing Results on Functionality Compliance

No.	Statement	Answer (Yes / No)
1	LINE application has the functionality to exchange text messages.	Yes
2	LINE application has the functionality to exchange picture messages.	Yes
3	LINE application has the functionality to exchange voice messages.	Yes
4	LINE application has the functionality to exchange video messages.	Yes
5	LINE application has the functionality to call through the Internet.	Yes

Table 4.81 shows that the five standard functionality that must be owned by LINE application as instant messenger applications have been met. From these results it can be seen that the quality testing of Functionality Compliance subcharacteristic scored with a score of 5. This indicates the LINE app has a standard instant messenger applications are excellent for use by the user.

5. Interoperability

LINE application testing on Interoperability subcharacteristic tested using Blackbox Testing. The test is performed by observing the interaction between the existing functionality in LINE applications with other systems that are outside the software. Results of testing the quality of Interoperability subcharacteristic can be seen in Table 4.82.

Table 4.82 LINE Testing Results on Interoperability Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Sign In Reset Password by Email	Password reset is done will be emailed to the user, such as Gmail or Yahoo!	Password reset performed successfully sent to the user email, such as Gmail or Yahoo!	Success

No.	Test Case	Expected Results	Actual Results	Status
2	Chatting			
	a. Attach or Add Picture Gallery in smartphone	The overall picture in the Gallery will appear, so the user can select the desired image	The overall picture in the Gallery managed to emerge, so that the user can select the desired image	Success
	b. Attach files with File Directory smartphones	Overall directories will appear, so the user can select the desired file in the destination directory	The entire directory managed to emerge, so that the user can select the desired file in the destination directory	Success
	c. Attach files in Dropbox	Overall Dropbox directory will appear, so the user can select the desired file in the destination directory	Overall Dropbox directory managed to emerge, so that the user can select the desired file in the destination directory	Success
	d. See map with maps application	Location coordinates sent by the sender of the message will be seen by the message recipient using the maps app, like GMaps or Waze	Location coordinates sent by the sender of the message recipient views the message by using the maps app, like GMaps or Waze	Success
	e. Email Chat application system with email, chat, and cloud computing	Overall chat will be sent via e-mail applications, chat, and cloud computing, such as Gmail, Mail (the default application on the smartphone), Drive, and Skype	Overall chat successfully sent via email applications, chat, and cloud computing, such as Gmail, Mail (the default application on the smartphone), Drive, and Skype	Success
3	Friends			
	c. Add Contact by email with email application	The user's contact invitation will be sent to the other user's email application intended by email, such as Gmail or Mail (the default application on the smartphone)	Invite contacts the user's email successfully delivered to other users through a targeted email application, such as Gmail or Mail (the default application on the smartphone)	Success
	d. Add Contact by SMS to the SMS application	The user's contact invitation will be sent via SMS application	Invitation successfully transmitted the user's contacts through SMS applications	Success

No.	Test Case	Expected Results	Actual Results	Status
4	Profile Share QR Code with media	QR Code belonging to the user will be shared to media that can be selected, such as Bluetooth, Mail, Messaging, Notes, Facebook, WhatsApp, LINE, and so on	QR Code belonging to the user successfully shared to media that can be selected, such as Bluetooth, Mail, Messaging, Notes, Facebook, WhatsApp, LINE, and so on	Success

Table 4.82 shows that LINE application has had to do with the interaction of 9 systems which are outside the software. From these results it can be seen that the quality testing of Interoperability subcharacteristic gain value with a score of 5. This indicates LINE applications have excellent interoperability.

4.7.2 Testing of Reliability Characteristics

LINE application quality on Android-based are tested on Reliability characteristic consists of four subcharacteristic to be assessed. Fourth subcharacteristic include Maturity, Fault Tolerance, Reliability Compliance, and Recoverability. Reliability characteristics testing against each subcharacteristic are as follows:

1. Maturity

LINE application testing on Maturity subcharacteristic tested using Blackbox Testing. The test is performed by observing the frequency of failure can be avoided due to a software error. Results of testing the quality of Maturity subcharacteristic can be seen in Table 4.83.

Table 4.83 LINE Testing Results on Maturity Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Send a message to the various characters and emoticons to a message recipient 100 times in the same time	The message will be sent as much as 100 times to a recipient of the message in the same time	The message is sent as many as 100 times to a recipient of the message in the same time	Success
2	Send a message to the various characters and emoticons to 100 recipients in the same time	The message will be sent to 100 recipients in the same time	The message is sent to 100 recipients in the same time	Success
3	Multi Send Message to 100 recipients in the same time	The message will be sent to 100 recipients in the same time	The message is sent to 100 recipients in the same time	Success

Table 4.83 indicates that all test cases totaling 3 successfully tested. From the results of the test case, it is known that the testing of the quality of Maturity subcharacteristic scored with a score of 5. This is because 100% message function on a LINE application has been able to avoid failure frequency properly due to improper application.

2. Fault Tolerance

LINE application testing on Fault Tolerance subcharacteristic tested using the method BlacBox Testing. The test is performed by observing capability in maintaining LINE application performance by providing fault tolerance in the event of a system fault or human error. Results of testing the quality of Fault Tolerance subcharacteristic can be seen in Table 4.84.

Table 4.84 LINE Testing Results on Fault Tolerance Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Sign Up			

No.	Test Case	Expected Results	Actual Results	Status
2	a. Create an account by entering a phone number that does not match by more than 10 times	Accounts created will fail and not obtain SMS verification of the LINE	Accounts failed to be created and do not get an SMS verification of the LINE	Success
	b. Create an account by entering an email address that does not match by more than 10 times	Account will fail to be made if the email address does not match	Account has been successfully created despite email addresses do not match	Failed
	c. Create an account by entering a password that does not meet the requirement by more than 10 times	Accounts created will fail if the password is not eligible	Account created successfully fail because the password is not eligible to re-enter the password 30 times	Success
Log In				
3	a. Sign In by entering your email address and password that does not match by more than 10 times	Sign In failing to do and appear notification to let users fill in your email address and password back	Sign In successfully cannot be processed and a notification to let users fill in your email address and password back.	Success
	b. Reset the password by entering an email address that does not match by more than 10 times	Reset password failed due to not get the password from the LINE via email	Reset password is not successfully processed because not get the password from the LINE via email	Success
Friends				
3	a. Adding contacts via QR Code Reader to scan the QR Code is wrong by more than 10 times	Contacts will fail to be added and sent to the designated contact	Contacts succeed fail to plus and failed to be sent to the designated contact by trying to scan the QR code incorrectly 30 times	Success
	b. Adding contacts through the ID by entering an incorrect ID is more than 10 times	ID will not be found so that the contact failure plus contact and sent to the addressee	ID managed not to be found so that the contact failure plus contact and sent to the addressee by trying to enter the wrong ID 30 times	Success

Table 4.84 shows that the six test case succeeded and one failed of seven test cases tested. From the results of the test case, it is known that the testing of the quality of Fault Tolerance subcharacteristic gain value with a score of 5. This is because 86% of LINE applications can provide with excellent fault tolerance in the event of a system error or a user made a mistake on the application.

3. Reliability Compliance

LINE application testing on Reliability Compliance subcharacteristic tested using Guttman Scale. The test is performed by measuring reliability that of the standard application of LINE as instant messenger applications. Results of testing the quality of Reliability Compliance subcharacteristic can be seen in Table 4.85.

Table 4.85 LINE Testing Results on Reliability Compliance Aspect

No.	Statement	Answer (Yes / No)
1	LINE applications have reliability in providing fault tolerance more than 60% chance	Yes
2	LINE application has the reliability in avoiding more than 60% frequency of message delivery failure	Yes
3	LINE application has the reliability in continuing its work back and restore user data when it occurs more than 2 errors in the system or network connection	Yes

Table 4.85 shows that three reliability standards that should be owned by LINE application as instant messenger applications have been met. LINE application is able to provide fault tolerance of 86%, 100% avoid malfunction messaging, and continuing throughout his job back and

recover all the user data when a system error occurs. From these results it can be seen that the quality testing of Reliability Compliance subcharacteristic gain value with a score of 4. This indicates LINE application has had instant messenger application reliability standards suitable for use by users.

4. Recoverability

LINE application testing on Recoverability subcharacteristic is tested by using the method Blackbox Testing. The test is performed by observing capabilities LINE application in continuing its work back and restore user data in the event of an error in the system software and network connections. Results of testing the quality of Recoverability subcharacteristic can be seen in Table 4.86.

Table 4.86 LINE Testing Results on Recoverability Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Send a message when the sender or recipient of the message was no network	The message has not been sent, but will go into the server to be executed when the network is available	The message has not been sent, but has entered into the server to be executed when the network is available	Success
2	While the message is being typed, there is an incoming call	The message being typed will not be lost	The message being typed managed not lost, so the user can continue writing the message	Success
3	While the message is being typed, the user switches to another application to minimize application LINE	The message being typed will not be lost	The message being typed managed not lost, so the user can continue writing the message	Success
4	While the message is being typed, the user out of the application	The message being typed will not be lost and will be stored on	The message being typed managed not lost and already stored	Success

No.	Test Case	Expected Results	Actual Results	Status
		the chat between the sender and receiver of the message	in the chat between the sender and receiver of the message	
5	While the message is being typed, the smartphone experience restart or shutdown	The message being typed will not be lost and will be stored on the chat between the sender and receiver of the message	The message being typed managed not lost and already stored in the chat between the sender and receiver of the message	Success

Table 4.86 shows that the entire test case was successfully tested. From the results of the test case, it is known that the testing of the quality of Recoverability subcharacteristic gain value with a score of 5. This is because the function of recovery in LINE applications has been able to continue its work back and restore user data when a system error occurs five or network connection.

4.7.3 Testing of Efficiency Characteristics

LINE application quality on Android-based are tested on Efficiency characteristic consists of three subcharacteristic to be assessed. Third subcharacteristic include Time Behaviour, Resource Utilization, and Efficiency Compliance. Efficiency characteristics testing against each subcharacteristic are as follows:

1. Time Behaviour

LINE application testing on Time Behaviour subcharacteristic tested using Blackbox Testing. The test is performed by measuring the speed of

LINE applications under 3K/s in response and processing time when carrying out its functions. The speed measurement is done using a stopwatch application. Results of testing the quality of Time Behaviour subcharacteristic can be seen in Table 4.87.

Table 4.87 LINE Application Testing Results on Time Behaviour

No.	Test Case	Expected Results	Actual Results	Status
1	Send a text message with the character: a. Lowercase (a-z) b. Capital letters (A-Z) c. Figures (0-9) d. Punctuation mark e. Emoticon	Response and processing time on a short message with these characters will spend a maximum of 3 milliseconds	Short messages with these characters manage to spend time during the 1,295 millisecond	Success
2	Send normal message with the character: a. Lowercase (a-z) b. Capital letters (A-Z) c. Figures (0-9) d. Punctuation mark e. Emoticon	Response and processing time on a short message with these characters will spend a maximum of 4 milliseconds	Normal message delivery with these characters manage to spend time during the 1,582 millisecond	Success
3	Send a message length character: a. Lowercase (a-z) b. Capital letters (A-Z) c. Figures (0-9) d. Punctuation mark e. Emoticon	Response and processing time on a short message with these characters will spend a maximum of 5 milliseconds	Length of message delivery with these characters manage to spend time during the 1,674 millisecond	Success

Table 4.87 shows that LINE application to have the response and processing times at short messages during 1,295 milliseconds, normal message during 1,582 milliseconds, and long messages during 1,674 milliseconds. From these results it can be seen that the quality testing of Time Behaviour subcharacteristic gain value with a score of 4. This indicates LINE application have a response and a good process.

2. Resource Utilization

LINE applications testing on Resource Utilization subcharacteristic tested using Blackbox Testing. The test is performed by observing the utilization of available resources LINE applications when carrying out its functions. Results of testing the quality of Resource Utilization subcharacteristic can be seen in Table 4.88.

Table 4.88 LINE Application Testing Results on Resource Utilization

No.	Test Case	Expected Results	Actual Results	Status
1	Check the RAM storage in Settings Smartphone	The maximum amount of RAM that is used when running the application function is 60 MB	When running an application function, RAM used successfully use a size of 60 MB	Success
2	Check Memory Settings application on Smartphone	The maximum amount of memory that is used when running the application functionality is 65 MB	When running an application function, Memory used successfully use the size of 62.66 MB	Success

Table 4.88 shows that LINE application spending RAM storage resource by 60 MB and Memory at 62.66 MB. From these results it can be seen that the quality testing of Resource Utilization subcharacteristic gain value with a score of 3. This indicates LINE application have sufficient resources consumption both when running the application functionality.

3. Efficiency Compliance

LINE application testing on Efficiency Compliance subcharacteristic tested using Guttman Scale. The test is performed by measuring the

efficiency of existing on LINE application as a standard instant messenger applications. Results of testing the quality of Efficiency Compliance subcharacteristic can be seen in Table 4.89.

Table 4.89 LINE Application Testing Results on Efficiency Compliance

No.	Statement	Answer (Yes / No)
1	LINE application has efficiency in exchanging text messages with exceeding 1,224 characters exist on SMS	Yes
2	LINE applications have response and efficiency in delivering maximum processing time of 2 milliseconds on short messages (<80 characters)	Yes
3	LINE applications have response and efficiency in delivering maximum processing time of 2.5 milliseconds at normal messages (81-160 characters)	Yes
4	LINE applications have response and efficiency in delivering maximum processing time of 3 milliseconds on message length (> 160 characters)	Yes
5	LINE applications have maximum efficiency in storage RAM 60 MB	Yes
6	LINE application has a maximum efficiency in storage memory 65 MB	Yes

Table 4.89 shows that efiesensi six standards that must be owned by LINE application as instant messenger applications have been met. LINE application can contain up to 2,000 characters of text messages, send short messages during 1.295 milliseconds, send normal messages during 1.582 milliseconds, send a long message for 1.674 milliseconds, spent 60 MB of RAM for storage, and using 62.66 MB for memory storage applications. From these results it can be seen that the quality testing of subcharacteristic Efficiency Compliance scored with a score of 5. This indicates the LINE app has had a very good efficiency standards to be used by the user.

4.7.4 Testing of Usability Characteristics

LINE application quality on Android-based are tested on Usability characteristic consists of five subcharacteristic to be assessed. Fifth subcharacteristic include Operability, Learnability, Understandability, Attractiveness, and Usability Compliance. Usability characteristics testing against each subcharacteristic conducted by questionnaire J.R Lewis by the number of respondents as many as 204 respondents. Results of the questionnaire processing of existing subcharacteristic on Usability characteristics can be seen in Table 4.90.

Table 4.90 LINE Testing Results on Usability Characteristics

No.	Subcharacteristic	The Most Answers	Percentage Feasibility
1	Operability	Agree	41.54%
2	Learnability	Agree	51.72%
3	Understandability	Agree	48.69%
4	Attractiveness	Agree	44.73%
5	Usability Compliance	Agree	42.40%

Table 4.90 shows that 41.54% of respondents agree Operability aspect provide user convenience in operating applications, 51.72% of respondents agreed Learnability aspect provides convenience in studying the application, 48.69% of respondents agree Understandability aspect provide user convenience in understanding the application, 44.73% of respondents agreed aspects of Attractiveness provide power attraction for users, as well as 42.40% of respondents agree Usability Compliance aspects complies with the standards instant messenger applications. Based on indicators that have been determined and the feasibility percentage obtained, it can be seen that the quality testing of:

1. Operability Subcharacteristic quite enough with a score of 3.
2. Learnability Subcharacteristic quite good with a score of 4.
3. Understandability Subcharacteristic quite good with a score of 4.
4. Attractiveness Subcharacteristic quite enough with a score of 3.
5. Usability Compliance Subcharacteristic is quite with a score of 3.

4.7.5 Testing of Portability Characteristics

LINE application quality on Android-based are tested on Portability characteristic consists of five subcharacteristic to be assessed. Fifth subcharacteristic include Installability, Adaptability, Portability Compliance, replaceability, and Coexistence. Portability characteristics testing against each subcharacteristic are as follows:

1. Installability

LINE application testing on Installability subcharacteristic tested using Guttman Scale. The test is performed by observing capabilities LINE applications during the installation on different environments. Environmental question is the Android operating system version used by the 204 respondents with various smartphone screen size of <5 inch. Results of testing the quality of Installability subcharacteristic can be seen in Table 4.91.

Table 4.91 LINE Testing Results at Installability Aspect

No.	Statement	Answer (Yes / No)
1	The installation process successfully run well on the operating system Android 2.3 - 2.3.7 Gingerbread smartphone screen size of <5 inch.	Yes
2	The installation process successfully run well on the operating system Android 4.1 - Jelly Bean 4.3 on a smartphone screen size of <5 inch.	Yes
3	The installation process successfully run well on the operating system Android 4.0 - 4.0.4 Ice Cream Sandwich on the smartphone screen size of <5 inch.	Yes
4	The installation process successfully run well on the operating system Android 4.4 KitKat on the smartphone screen size of <5 inch.	Yes
5	The installation process successfully run well on the operating system Android 5.0 smartphone screen size Lollipop at <5 inch.	Yes

Table 4.91 indicates that the installation process on LINE application successful runs fine on the fifth Android operating system, namely Gingerbread, Jelly Bean, Ice Cream Sandwich, KitKat, and Lollipop. From these results it can be seen that the quality testing of Installability subcharacteristic gain value with a score of 5. This indicates LINE application has been able to perform the installation process very well.

2. Adaptability

LINE application testing on Adaptability subcharacteristic tested using Guttman Scale. The test is performed by observing the ability to adapt to the LINE application environments different. Environmental question is the Android operating system version used by the 204 respondents with various smartphone screen size of <5 inch. Results of testing the quality of Adaptability subcharacteristic can be seen in Table 4.92.

Table 4.92 LINE Testing Results on Adaptability Aspect

No.	Statement	Answer (Yes / No)
1	All functions run well on the operating system Android 2.3 - 2.3.7 Gingerbread smartphone screen size of <5 inch.	Yes
2	All functions run well on the operating system Android 4.1 - Jelly Bean 4.3 on a smartphone screen size of <5 inch.	Yes
3	All functions run well on the operating system Android 4.0 - 4.0.4 Ice Cream Sandwich on the smartphone screen size of <5 inch.	Yes
4	All functions run properly on Android 4.4 KitKat operating system on a smartphone screen size of <5 inch.	Yes
5	All functions run properly on Android 5.0 operating system Lollipop in the smartphone screen size of <5 inch.	Yes

Table 4.92 indicates that the function LINE application successful runs fine on the fifth Android operating system, namely Gingerbread, Jelly Bean, Ice Cream Sandwich, KitKat, and Lollipop. From these results it can be seen that the quality testing of Adaptability subcharacteristic gain value with a score of 5. This indicates LINE application has been able to adapt very well.

3. Portability Compliance

LINE application testing on Portability Compliance subcharacteristic tested using Guttman Scale. The test is performed by measuring the availability of portability that of the standard applications LINE as instant messenger applications. Results of testing the quality of Portability Compliance subcharacteristic can be seen in Table 4.93.

Table 4.93 LINE Testing Results on Portability Compliance

No.	Statement	Answer (Yes / No)
1	LINE has portability for applications running on the smartphone screen size of <5 inch	Yes

No.	Statement	Answer (Yes / No)
2	LINE has the portability of applications to run on the fifth Android operating system (Gingerbread, Jelly Bean, Ice Cream Sandwich, KitKat, and Lollipop)	Yes
3	LINE has the portability of applications to install applications on the Android operating system fifth without having to change the identity of the operating system or previous smartphone	Yes
4	LINE application to have portability of more than 60% to coexist with shared resources on other software in the environment	Yes
5	LINE has the portability of applications to replace more than 3 software similar	Yes

Table 4.93 shows that five portability standards that must be owned by LINE application as instant messenger applications have been met. LINE application is able to run and install applications on the smartphone screen size of <5 inch Android Gingerbread operating system, Jelly Bean, Ice Cream Sandwich, KitKat, and Lollipop. In addition, this application is also able to co-exist with other software with a percentage of 75% and capable of replacing eight similar software. From these results it can be seen that the quality testing of Portability Compliance subcharacteristic scored with a score of 4. This indicates LINE application already has good portability standards to be used by the user.

4. Replaceability

LINE application testing on Replaceability subcharacteristic tested using Guttman Scale. The test is performed by observing the functions on the LINE app replaces instant messenger applications similar to the user's friend contact terms are also present in the relevant application. Results

of testing the quality of Replaceability subcharacteristic can be seen in Table 4.94.

Table 4.94 LINE Testing Results at Replaceability Aspect

No.	Statement	Answer (Yes / No)
1.	Multimedia message (text, images, sound, video), emoticons, free call / voice calls, as well as the group chat on the LINE app can replace the existing features in the application: a. WhatsApp b. BlackBerry Messenger (BBM) c. WeChat d. KakaoTalk e. Hangouts by Google f. Yahoo Messenger g. Facebook Messenger h. Skype	Yes Yes Yes Yes Yes Yes Yes Yes

Table 4.94 shows that LINE application can replace features that exist in eight instant messenger application that is similar. Features on WhatsApp, BlackBerry Messenger, WeChat, KakaoTalk, Hangouts by Google, Yahoo Messenger, Facebook Messenger, and Skype features include multimedia messaging (text, images, sound, video), emoticons, free call or a voice call, and group chat , From these results it can be seen that the quality testing of Replaceability subcharacteristic gain value with a score of 5. This indicates LINE application capable of acting as an instant messenger application that can replace similar software very well.

5. Coexistence

LINE application testing on Coexistence subcharacteristic tested using Blackbox Testing. The test is performed by observing capabilities LINE application when side by side with other software in the environment by

sharing resources. Results of testing the quality of Coexistence subcharacteristic can be seen in Table 4.95.

Table 4.95 LINE Testing Results on Coexistence Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Chatting			
	a. Attach or Add Picture Gallery in smartphone	RAM usage in the gallery will be allocated to the RAM usage on LINE	RAM usage at the Gallery successfully allocated to RAM usage on LINE	Success
	b. See map with maps application, which GMaps	RAM usage on GMaps will be allocated to the RAM usage on LINE	RAM usage on GMaps successfully allocated to RAM usage on LINE	Success
	c. See map with maps application, which Waze	RAM usage on Waze will be allocated to the RAM usage on LINE	Waze failed RAM usage on the use of RAM allocated to the LINE	Failed
	d. Email Conversation with the email application, namely Gmail and Mail (the default application)	RAM usage on Gmail and Mail will be allocated to the RAM usage on LINE	RAM usage on Gmail and Mail successfully allocated to RAM usage on LINE	Success
	e. Email Conversation with the chat application, namely Skype	RAM usage on Skype will be allocated to the RAM usage on LINE	RAM usage on Skype successfully allocated to RAM usage on LINE	Success
	f. Email Conversation with cloud computing applications, the Drive	RAM usage on the drive will be allocated to the RAM usage on LINE	RAM usage on the drive successfully the use of RAM allocated to the LINE	Success
	g. Chatting with Camera	RAM usage on Camera will be allocated to the RAM usage on LINE	Camera successfully RAM usage on the use of RAM allocated to the LINE	Success

No.	Test Case	Expected Results	Actual Results	Status
2	Friends			
	a. Add Contact by email to the email application, namely Gmail and Mail (the default application)	RAM usage on Gmail and Mail will be allocated to the RAM usage on LINE	RAM usage on Gmail and Mail successfully allocated to RAM usage on LINE	Success
3	b. Add Contact by SMS to the SMS application, namely Messaging (application default)	RAM usage in Messaging will be allocated to the RAM usage on LINE	RAM usage on the Messaging failed allocated to RAM usage on LINE	Failed
	Profile			
	a. Share QR Code with media, such as Cloud Album, Mail, Gmail, Notes, Dropbox, Drive, Skype	RAM usage on these media will be allocated to the RAM usage on LINE	RAM usage on these media successfully allocated to the RAM usage on LINE	Success
	b. Share QR Code with media, such as Messaging, BlackBerry Messenger, WhatsApp, Facebook	RAM usage on these media will be allocated to the RAM usage on LINE	RAM usage on these media failed to use the RAM allocated to the LINE	Failed
	c. Change Profile Photo Gallery and Camera	RAM usage on the Gallery and Camera will be allocated to the RAM usage on LINE	RAM usage on the Gallery and Camera successfully allocated to RAM usage on LINE	Success

Table 4.95 shows that 9 test case succeeded and 3 failed of 12 test cases were tested. From these results it can be seen that the quality testing of Coexistence subcharacteristic gain value with a score of 4. This is because 75% LINE applications can co-exist well when sharing resources on other software in the environment.

4.7.6 Testing of Maintainability Characteristics

LINE application quality on Android-based are tested on Maintainability characteristic consists of two subcharacteristic to be assessed. Both subcharacteristic include Analyzability and Maintainability Compliance. Maintainability characteristics testing against each subcharacteristic are as follows:

1. Analyzability

LINE application testing on Analyzability subcharacteristic tested using Blackbox Testing. Testing is done by observing the deficiency diagnosis or cause of the failure on the LINE app. Results of testing the quality of Analyzability subcharacteristic can be seen in Table 4.96.

Table 4.96 LINE Testing Results on Analyzability Aspect

No.	Test Case	Expected Results	Actual Results	Status
1	Sign Up			
	a. Create an account by entering an incorrect phone number	The account will not be created and appear notice that the phone number is not valid	Accounts failed to be created and a notification that the phone number is not valid	Success
2	b. Create an account by entering a verification code is wrong	The account will not be created and appear notices that wrong verification code	Accounts failed to be created and appear notices that wrong verification code	Success
	Log In			
3	a. Log In to not enter an email address and password	Login will not be successful because the OK button is not active	Log In unsuccessful because the OK button	Success
	b. Log In via Facebook by entering less than 4 digit PIN	Log In will not succeed and emerge notification that the user must enter a 4-digit PIN	Log In unsuccessful and appear notification that the user must enter a 4-digit PIN	Success
3	Groups			
	Create Groups with not insert member	Group will fail to be made and a	Group successfully created although not	Failed

No.	Test Case	Expected Results	Actual Results	Status
		notification that the members should be included in advance	yet have members and does not display a notification that the members should be included in advance	

Table 4.96 shows that 4 successful test case and 1 that fails of 5 test cases tested. From the results of the test case, it is known that the testing of the quality of Analyzability subcharacteristic gain value with a score of 4. This is because 80% function deficiency diagnosis or cause of the failure on the LINE app has been available and running properly.

2. Maintainability Compliance

LINE application testing on Maintainability Compliance subcharacteristic tested using Guttman Scale. The test is performed by measuring the maintenance associated LINE application as a standard instant messenger applications. Results of testing the quality of Maintainability Compliance subcharacteristic can be seen in Table 4.97.

Table 4.97 LINE Testing Results on Maintainability Compliance

No.	Statement	Answer (Yes / No)
1	LINE application has deficiencies or maintenance in diagnosing the cause of the failure of more than 40% when running a function	Yes
2	LINE application service reports if the user finds an error or bug	Yes
3	LINE has a maintenance application in the development of applications continue updating	Yes

Table 4.97 shows that the three standards of maintenance that must be owned by LINE application as instant messenger applications have been

met. LINE application is able to diagnose 80% of the causes of failure, have service reports if the user finds an error or bug, as well as continue to provide updates on the development application. From these results it can be seen that the quality testing of Maintainability Compliance subcharacteristic scored with a score of 4. This indicates LINE application has a standard instant messenger application maintenance is good.

4.7.7 Quality Testing Results of LINE Messenger Application

The value of LINE application quality test results for each characteristic has been obtained. This value is inserted into the variable c by calculating the total value of subcharacteristic as follows:

1. Functionality

- a. Security : $25.7\% * 5 = 25.7\%$
- b. Accuracy : $25.7\% * 5 = 25.7\%$
- c. Suitability : $20.6\% * 5 = 20.6\%$
- d. Compliance Functionality : $18.8\% * 5 = 18.8\%$
- e. Interoperability : $9.1\% * 5 = 9.1\%$

2. Reliability

- a. Maturity : $28.9\% * 5 = 28.9\%$
- b. Fault Tolerance : $28.9\% * 5 = 28.9\%$
- c. Reliability Compliance : $24.6\% * 4 = 19.7\%$
- d. Recoverability : $17.5\% * 5 = 17.5\%$

3. Efficiency

- a. Time Behaviour : 33.3% * 4 = 26.6%
- b. Resource Utilization : 33.3% * 3 = 20%
- c. Efficiency Compliance : 33.3% * 5 = 33.3%

4. Usability

- a. Operability : 29.6% * 3 = 17.8%
- b. Learnability : 21.7% * 4 = 17.4%
- c. Understandability : 18.5% * 4 = 14.8%
- d. Attractiveness : 17.5% * 3 = 10.5%
- e. Usability Compliance : 12.7% * 3 = 7.6%

5. Portability

- a. Installability : 33.6% * 5 = 33.6%
- b. Adaptability : 23.2% * 5 = 23.2%
- c. Portability Compliance : 18.7% * 4 = 15%
- d. Replaceability : 13.4% * 5 = 13.4%
- e. Coexistence : 11.1% * 4 = 8.9%

6. Maintainability

- a. Analyzability : 50% * 4 = 40%
- b. Maintainability : 50% * 4 = 40%

Of the total acquisition value of each subcharacteristic, the total value of factor analysis of each characteristic can be obtained by multiplying the value of each subcharacteristic grand total weight characteristics. Calculation of the total value of factor analysis of each characteristic in ISO 9126-1 Quality Model is as follows:

1. Functionality : $(25.7\% + 25.7\% + 20.6\% + 18.8\% + 9.1\%) * 45.3\% = 45.3\%$
2. Reliability : $(28.9\% + 28.9\% + 19.7\% + 17.5\%) * 24\% = 22.8\%$
3. Efficiency : $(26.6\% + 20\% + 33.3\%) * 11.9\% = 9.5\%$
4. Usability : $(17.8\% + 17.4\% + 14.8\% + 10.5\% + 7.6\%) * 9\% = 6.1\%$
5. Portability : $(33.6\% + 23.2\% + 15\% + 13.4\% + 8.9\%) * 6.2\% = 5.8\%$
6. Maintainability: $(40\% + 40\%) * 3.6\% = 2.9\%$

Results of calculation of the total value of each subcharacteristic and the total value of factor analysis of each characteristic described in Table 4.98. From the table, the grand total value of factor analysis on LINE application can know the percentage of quality applications.

Table 4.98 LINE Application Quality Testing Results

No	Characteristic	Weight	Subcharacteristic	Weight Value (w)(0-1)	Value	Total of Value Each Subcharacteristic	Total of Value Each Characteristic
		Max Value			(c)		
1	Functionality	45.3%	Security	25.7%	5	25.7%	45.3%
			Accuracy	25.7%	5	25.7%	
			Suitability	20.6%	5	20.6%	
			Functionality Compliance	18.8%	5	18.8%	
			Interoperability	9.1%	5	9.1%	
2	Reliability	24.0%	Maturity	28.9%	5	28.9%	22.8%
			Fault Tolerance	28.9%	5	28.9%	
			Reliability Compliance	24.6%	4	19.7%	
			Recoverability	17.5%	5	17.5%	
3	Efficiency	11.9%	Time Behaviour	33.3%	4	26.6%	9.5%
			Resource Utilization	33.3%	3	20.0%	
			Efficiency Compliance	33.3%	5	33.3%	
4	Usability	9.0%	Operability	29.6%	3	17.8%	6.1%
			Learnability	21.7%	4	17.4%	
			Understandability	18.5%	4	14.8%	
			Attractiveness	17.5%	3	10.5%	
			Usability Compliance	12.7%	3	7.6%	
5	Portability	6.2%	Installability	33.6%	5	33.6%	5.8%
			Adaptability	23.2%	5	23.2%	
			Portability Compliance	18.7%	4	15.0%	
			Replaceability	13.4%	5	13.4%	
			Coexistence	11.1%	4	8.9%	
6	Maintainability	3.6%	Analyzability	50.0%	4	40.0%	2.9%
			Maintainability Compliance	50.0%	4	40.0%	
	Jumlah	100%					92%

Table 4.98 shows that the quality of LINE applications obtained was 92%. From the test results, Functionality characteristics obtain a percentage of 45.3%, amounting to 22.8% Reliability, Efficiency at 9.5%, 6.1% Usability, Portability amounted to 5.8%, and 2.9% Maintainability. Overall, the quality of each

characteristic LINE app has been good with the majority of the value of the variable c is 4 and 5. However, there are still subcharacteristic which has a value of 3, so that needs to be addressed further. Subcharacteristic include Resource Ulization, Operability, Attractiveness, and Usability Compliance.

4.8 Results and Comparison of Quality Each Instant Messenger Application

The quality of the most popular instant messenger applications have obtained the percentage results through testing that has been done. There are some characteristics that were tested by the method of BlackBox testing, questionnaires J.R Lewis, and Guttman Scale. Results of the quality of the third instant messenger applications described in Figure 4.15.

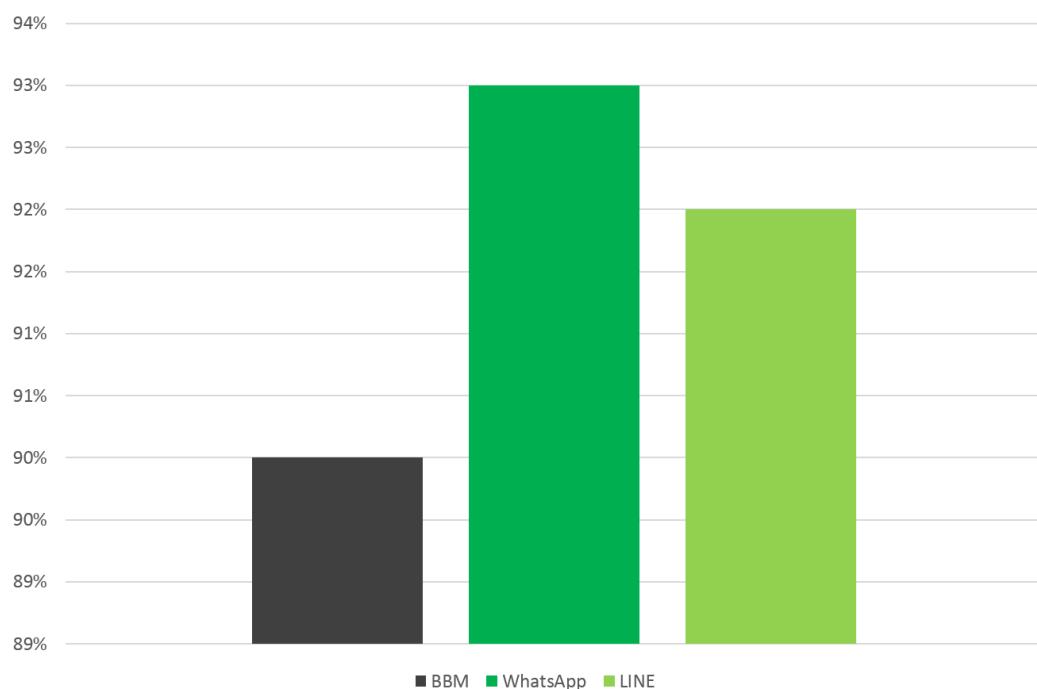


Figure 4.15 The Graph Comparisons Three Quality Instant Messenger Application

Figure 4.15 shows that the instant messenger application that has the highest percentage of 93% is WhatsApp Messenger, followed by LINE with 92% and BlackBerry Messenger (BBM) by 90%. This indicates that the level of the order of popularity of instant messenger applications (BBM > WhatsApp > LINE) is not in accordance with the order of a third quality is instant messenger application (WhatsApp > LINE > BBM).

5 CONCLUSION REMARKS

5.1 Conclusion

Quality valuation of BlackBerry Messenger (BBM), WhatsApp, and LINE applications with standard ISO 9126-1 Quality Model has been successfully tested by the methods specified. Broadly, the three most popular instant messenger applications, according to Nielsen On Device Meter (ODM) is obtaining good quality with a percentage value between 90% to 93%. The quality value of each application is affected by the weight and subcharacteristic value. Sequencing weights on each characteristic and subcharacteristic that exist in the ISO 9126-1 Quality Model obtained from the questionnaires results of 30 respondents to the Analytic Hierarchy Process (AHP) method. Respondent data is then processed using tools BPMSG AHP Priority Calculator with Consistency Ratio (CR) value <10, so that the results of sorting the weights can be expressed accurately and reliably.

On Functionality characteristics, WhatsApp and LINE application have a value equal to the characteristic of functionality and reliability. Both have quality functionality with a percentage of 45.3%, followed by the BlackBerry Messenger (BBM) amounted to 42.9%. This is because WhatsApp and LINE have a value functionality on Security subcharacteristic is better than BlackBerry Messenger (BBM). On the quality of reliability, WhatsApp and LINE obtain a percentage of 22.8% and BlackBerry Messenger (BBM) of 21.4%. This is because the value of Maturity subcharacteristic on the application WhatsApp and LINE superior.

However, BlackBerry Messenger (BBM) application has a higher percentage value on the Efficiency characteristic with a percentage of 10.3%, followed LINE with 9.5%, and WhatsApp with 8.7%. This is because BlackBerry Messenger (BBM) applications has quality of Time Behaviour and Resource Utilization is better than WhatsApp and LINE.

On Usability characteristics, WhatsApp application superior with a percentage of 7.2%, followed by BlackBerry Messenger (BBM) with 6.7%, and LINE with 6.1%. This is because WhatsApp application better operability than the BlackBerry Messenger (BBM) and LINE. Attractiveness and usability compliance owned WhatsApp is also superior to the LINE application. While Portability characteristic, three popular instant messenger applications have quality equal to the percentage of each by 5.8%.

On Maintainability characteristics, BlackBerry Messenger (BBM) and WhatsApp applications have better maintenance with a percentage of 3.2%, followed by LINE with 2.9%. This is because the value of Analyzability subcharacteristic on WhatsApp and BlackBerry Messenger (BBM) is higher than LINE.

Instant messenger applications ranked according to Nielsen On Device Meter (ODM) sequentially beginning with BlackBerry Messenger (BBM) application. Then, the next rank is WhatsApp and LINE. However, such popularity is not aligned with the quality rank third performance of the application. Based on the testing results that has been done, the quality of performance are best obtained by application of WhatsApp (93%), LINE (92%), and BlackBerry Messenger (90%).

The percentage values indicate that the three popular instant messenger application is in compliance with international standardization through ISO 9126-1 Quality Model. However, the results of this test proves that the popularity of the three applications should not be a benchmark in its quality.

5.2 Suggestion

Based on the obtained results of the discussion, the quality of BlackBerry Messenger (BBM), WhatsApp, and LINE applications can be tested with the actual overall valuation ISO 9126-1 Quality Model. Filling out the questionnaire on the weighting of each characteristic and subcharacteristic ISO 9126-1 Quality Model and instant messenger applications observations need to be done by an experienced person or an expert in the field of Software Quality Assurance. In addition, filling out the questionnaire on Usability aspects of BlackBerry Messenger (BBM), WhatsApp, and LINE application can be spread evenly throughout Indonesia.

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APPENDIX

Appendix 1. Weight Determination Questionnaire of ISO 9126-1 Quality Model

Kuesioner Penentuan Bobot terhadap Faktor Kualitas Aplikasi Instant Messenger

Assalamu'alaikum Wr. Wb.

Sehubungan dengan adanya penelitian yang berjudul "Pengukuran Kualitas Aplikasi Instant Messenger Terpopuler di Indonesia pada Smartphone Berbasis Android" untuk penyelesaian tugas akhir. Bersama ini saya:

Nama : Nur Fisabilillah
Jurusan : Magister Sistem Informasi Bisnis, Universitas Gunadarma

Dengan segala kerendahan hati, memohon bantuan Anda yang menggunakan aplikasi instant messenger/chatting pada smartphone berbasis Android untuk mengisi angket ini. Jawaban yang Anda berikan semua adalah benar, tidak ada jawaban yang salah. Pastikan tidak ada jawaban yang kosong atau terlewattkan. Kerahasiaan atas data dan jawaban Anda akan dijamin oleh peneliti.

Atas ketersedian Anda untuk mengisi kuesioner ini, saya ucapan terima kasih.
Wassalamu'alaikum Wr. W.b.

Hormat saya,

Peneliti
(Nur Fisabilillah)

* Wajib

IDENTITAS RESPONDEN

Nama Inisial *

Jenis Kelamin *

Usia *

Gelar Anda *

Untuk mendukung kredibilitas kuesioner terhadap responden yang berlatarbelakang di bidang teknologi.

S.Kom

S.T

M.Kom

M.TI

MMSI

Yang lain:

Lamanya Anda Menggunakan Aplikasi Instant Messenger pada Smartphone Anda *

Misal: 5 tahun, sejak tahun 2010, sejak SMA

BOBOT APLIKASI INSTANT MESSENGER

Pernyataan-pernyataan di bawah ini berkaitan dengan persepsi Anda terhadap prioritas karakteristik dari aplikasi instant messenger. Berikut adalah skala pada setiap pernyataan-pernyataan dalam mengisi kuesioner ini.

- 1 = Kedua Elemen SAMA PENTING
 - 3 = Elemen ke-1 SEDIKIT LEBIH PENTING daripada Elemen ke-2
 - 5 = Elemen ke-1 LEBIH PENTING daripada Elemen ke-2
 - 7 = Elemen ke-1 SANGAT LEBIH PENTING daripada Elemen ke-2
 - 9 = Elemen ke-1 MUTLAK LEBIH PENTING daripada Elemen ke-2
 - 2, 4, 6, 8 = Nilai ini diberikan jika ada 2 Elemen DIANTARA 2 Pilihan
 - 0 = Elemen ke-2 LEBIH PENTING daripada Elemen ke-1

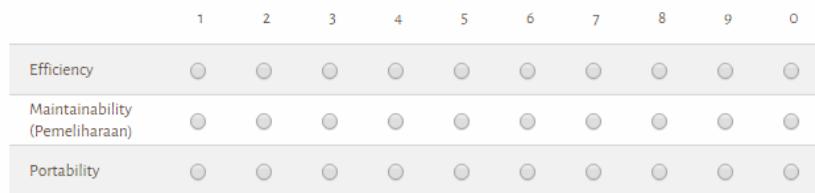
Karakteristik ISO 9126-1 Quality Model

- Functionality (Fungsionalitas):
Kemampuan perangkat lunak untuk menyediakan fungsi sesuai kebutuhan pengguna, ketika digunakan dalam kondisi tertentu.
 - Reliability (Kehandalan):
Kemampuan perangkat lunak untuk mempertahankan tingkat kinerja tertentu, ketika digunakan dalam kondisi tertentu.
 - Usability (Kebergunaan):
Kemampuan perangkat lunak untuk dipahami, dipelajari, digunakan, dan menarik bagi pengguna, ketika digunakan dalam kondisi tertentu.
 - Efficiency (Efisiensi):
Kemampuan perangkat lunak untuk memberikan kinerja yang sesuai dan relatif terhadap jumlah sumber daya yang digunakan pada saat keadaan tersebut.
 - Maintainability (Pemeliharaan):
Kemampuan perangkat lunak untuk dimodifikasi. Modifikasi meliputi koreksi, perbaikan atau adaptasi terhadap perubahan lingkungan, persyaratan, dan spesifikasi fungsional.
 - Portability (Portabilitas):
Kemampuan perangkat lunak untuk ditransfer dari satu lingkungan ke lingkungan lain.

Menurut Anda, seberapa penting faktor Functionality pada aplikasi instant messenger terhadap faktor: *

Menurut Anda, seberapa penting faktor Reliability (Kehandalan) pada aplikasi instant messenger terhadap faktor: *

Menurut Anda, seberapa penting faktor Usability (Kebergunaan) pada aplikasi instant messenger terhadap faktor: *



Menurut Anda, seberapa penting faktor Efficiency pada aplikasi instant messenger terhadap faktor: *



Menurut Anda, seberapa penting faktor Maintainability (Pemeliharaan) pada aplikasi instant messenger terhadap faktor: *



Sub Karakteristik Functionality

- Suitability (Kesesuaian):

Kemampuan perangkat lunak untuk menyediakan serangkaian fungsi yang sesuai untuk tugas-tugas tertentu dan tujuan pengguna.

- Accuracy (Akurasi):

Kemampuan perangkat lunak dalam memberikan hasil yang presisi dan benar sesuai dengan kebutuhan.

- Interoperability:

Kemampuan perangkat lunak untuk berinteraksi dengan satu atau lebih sistem tertentu.

- Security (Keamanan):

Kemampuan perangkat lunak untuk mencegah akses yang tidak diinginkan, menghadapi penyusup (hacker) maupun otorisasi dalam modifikasi data.

- Functionality Compliance (Kepatuhan Aturan):

Kemampuan perangkat lunak dalam memenuhi standar dan kebutuhan sesuai peraturan yang berlaku dengan fungsionalitas.

SKALA pada setiap pernyataan-pernyataan:

1 = Kedua Elemen SAMA PENTING

3 = Elemen ke-1 SEDIKIT LEBIH PENTING daripada Elemen ke-2

5 = Elemen ke-1 LEBIH PENTING daripada Elemen ke-2

7 = Elemen ke-1 SANGAT LEBIH PENTING daripada Elemen ke-2

9 = Elemen ke-1 MUTLAK LEBIH PENTING daripada Elemen ke-2

2, 4, 6, 8 = Nilai ini diberikan jika ada 2 Elemen DIANTARA 2 Pilihan

Menurut Anda, faktor mana yang lebih penting? Suitability (Kesesuaian) atau Accuracy (Akurasi)?^a

- Suitability (Kesesuaian)
- Accuracy (Akurasi)
- Sama Penting

Seberapa penting?^a

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Suitability (Kesesuaian) atau Security (Keamanan)?^a

- Suitability (Kesesuaian)
- Security (Keamanan)
- Sama Penting

Seberapa penting?^a

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Suitability (Kesesuaian) atau Interoperability?^a

- Suitability (Kesesuaian)
- Interoperability
- Sama Penting

Seberapa penting?^a

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Suitability (Kesesuaian) atau Functionality Compliance (Kepatuhan Aturan)?^a

- Suitability (Kesesuaian)
- Functionality Compliance (Kepatuhan Aturan)
- Sama Penting

Seberapa penting?^a

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Accuracy (Akurasi) atau Security (Keamanan)?^a

- Accuracy (Akurasi)
- Security (Keamanan)
- Sama Penting

Seberapa penting? *

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Menurut Anda, faktor mana yang lebih penting? Accuracy (Akurasi) atau Interoperability? *

- Accuracy (Akurasi)
 - Interoperability
 - Sama Penting

Seberapa penting? *

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Accuracy (Akurasi) atau Functionality Compliance (Kepatuhan Aturan)?

- Accuracy (Akurasi)
 - Functionality Compliance (Kepatuhan Aturan)
 - Sama Penting

Seberapa penting? *

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Security (Keamanan) atau Interoperability? *

- Security (Keamanan)
 - Interoperability
 - Sama Penting

Seberapa penting? *

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Security (Keamanan) atau Functionality Compliance (Kepatuhan Aturan)?*

- Security (Keamanan)
 - Functionality Compliance (Kepatuhan Aturan)
 - Sama Penting

Seberapa penting? *

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Interoperability atau Functionality Compliance (Kepatuhan Aturan)?*

- Interoperability
- Functionality Compliance (Kepatuhan Aturan)
- Sama Penting

Seberapa penting?*

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting  Mutlak Lebih Penting

Sub Karakteristik Reliability (Kehandalan)

- Maturity (Kematangan):

Kemampuan perangkat lunak untuk menghindari kegagalan sebagai akibat dari kesalahan dalam perangkat lunak.

- Fault Tolerance (Toleransi Kesalahan):

Kemampuan perangkat lunak untuk mempertahankan kinerjanya jika terjadi kesalahan perangkat lunak.

- Recoverability (Pemulihan):

Kemampuan perangkat lunak untuk membangun kembali tingkat kinerja ketika terjadi kegagalan sistem, termasuk data dan koneksi jaringan.

- Reliability Compliance (Kepatuhan Aturan):

Kemampuan perangkat lunak dalam memenuhi standar dan kebutuhan sesuai peraturan yang berlaku dengan kehandalan.

SKALA pada setiap pernyataan-pernyataan:

- 1 = Kedua Elemen SAMA PENTING
- 3 = Elemen ke-1 SEDIKIT LEBIH PENTING daripada Elemen ke-2
- 5 = Elemen ke-1 LEBIH PENTING daripada Elemen ke-2
- 7 = Elemen ke-1 SANGAT LEBIH PENTING daripada Elemen ke-2
- 9 = Elemen ke-1 MUTLAK LEBIH PENTING daripada Elemen ke-2
- 2, 4, 6, 8 = Nilai ini diberikan jika ada 2 Elemen DIANTARA 2 Pilihan

Menurut Anda, faktor mana yang lebih penting? Maturity (Kematangan) atau Fault Tolerance (Toleransi Kesalahan)?*

- Maturity (Kematangan)
- Fault Tolerance (Toleransi Kesalahan)
- Sama Penting

Seberapa penting?*

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting  Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Maturity (Kematangan) atau Recoverability (Pemulihan)?*

- Maturity (Kematangan)
- Recoverability (Pemulihan)
- Sama Penting

Seberapa penting? *

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

Menurut Anda, faktor mana yang lebih penting? Maturity (Kehandalan) atau Reliability Compliance (Kepatuhan Aturan)?*

- Maturity (Kehandalan)
 - Reliability Compliance (Kepatuhan Aturan)
 - Sama Penting

Seberapa penting? *

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Menurut Anda, faktor mana yang lebih penting? Fault Tolerance (Toleransi Kesalahan) atau Recoverability (Pemulihan)?*

- Fault Tolerance (Toleransi Kesalahan)
 - Recoverability (Pemulihan)
 - Sama Penting

Seberapa penting? ✎

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

Menurut Anda, faktor mana yang lebih penting? Fault Tolerance (Toleransi Kesalahan) atau Reliability Compliance (Kepatuhan Aturan)? *

- Fault Tolerance (Toleransi Kesalahan)
 - Reliability Compliance (Kepatuhan Aturan)
 - Sama Penting

Seberapa penting? *

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

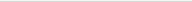
Menurut Anda, faktor mana yang lebih penting? Recoverability (Pemulihan) atau Reliability Compliance (Kepatuhan Aturan)?*

- Recoverability (Pemulihan)
 - Reliability Compliance (Kepatuhan Aturan)
 - Sama Penting

Seberapa penting? 

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting  Mutlak Lebih Penting

Sub Karakteristik Usability (Kebergunaan)

- Understandability (Mudah Dimengerti):
Kemampuan perangkat lunak dalam kemudahan untuk dipahami.

- Learnability (Mudah Dipelajari):
Kemampuan perangkat lunak dalam kemudahan untuk dipelajari.

- Operability
Kemampuan perangkat lunak dalam kemudahan untuk dioperasikan.

- Attractiveness (Daya Tarik)
Kemampuan perangkat lunak dalam menarik pengguna.

- Usability Compliance (Kepatuhan Aturan):
Kemampuan perangkat lunak dalam memenuhi standar dan kebutuhan sesuai peraturan yang berlaku dengan kebergunaan.

SKALA pada setiap pernyataan-pernyataan:

- 1 = Kedua Elemen SAMA PENTING
- 3 = Elemen ke-1 SEDIKIT LEBIH PENTING daripada Elemen ke-2
- 5 = Elemen ke-1 LEBIH PENTING daripada Elemen ke-2
- 7 = Elemen ke-1 SANGAT LEBIH PENTING daripada Elemen ke-2
- 9 = Elemen ke-1 MUTLAK LEBIH PENTING daripada Elemen ke-2
- 2, 4, 6, 8 = Nilai ini diberikan jika ada 2 Elemen DIANTARA 2 Pilihan

Menurut Anda, faktor mana yang lebih penting? Understandability (Mudah Dimengerti) atau Learnability (Mudah Dipelajari)?*

- Understandability (Mudah Dimengerti)
- Learnability (Mudah Dipelajari)
- Sama Penting

Seberapa penting?*

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Understandability (Mudah Dimengerti) atau Operability (Mudah Dioperasikan)?*

- Understandability (Mudah Dimengerti)
- Operability (Mudah Dioperasikan)
- Sama Penting

Seberapa penting?*

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Understandability (Mudah Dimengerti) atau Attractiveness (Daya Tarik)?*

- Understandability (Mudah Dimengerti)
- Attractiveness (Daya Tarik)
- Sama Penting

Seberapa penting?*

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting **Menurut Anda, faktor mana yang lebih penting? Understandability (Mudah Dimengerti) atau Usability Compliance (Kepatuhan Aturan)?***

- Understandability (Mudah Dimengerti)
- Usability Compliance (Kepatuhan Aturan)
- Sama Penting

Seberapa penting?*

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting **Menurut Anda, faktor mana yang lebih penting? Learnability (Mudah Dipelajari) atau Operability (Mudah Dioperasikan)?***

- Learnability (Mudah Dipelajari)
- Operability (Mudah Dioperasikan)
- Sama Penting

Seberapa penting?*

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting **Menurut Anda, faktor mana yang lebih penting? Learnability (Mudah Dipelajari) atau Attractiveness (Daya Tarik)?***

- Learnability (Mudah Dipelajari)
- Attractiveness (Daya Tarik)
- Sama Penting

Seberapa penting?*

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting **Menurut Anda, faktor mana yang lebih penting? Learnability (Mudah Dipelajari) atau Usability Compliance (Kepatuhan Aturan)?***

- Learnability (Mudah Dipelajari)
- Usability Compliance (Kepatuhan Aturan)
- Sama Penting

Seberapa penting?*

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Operability (Mudah Dioperasikan) atau Attractiveness (Daya Tarik)?^{*}

- Operability (Mudah Dioperasikan)
- Attractiveness (Daya Tarik)
- Sama Penting

Seberapa penting?^{*}

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Operability (Mudah Dioperasikan) atau Usability Compliance (Kepatuhan Aturan)?^{*}

- Operability (Mudah Dioperasikan)
- Usability Compliance (Kepatuhan Aturan)
- Sama Penting

Seberapa penting?^{*}

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Attractiveness (Daya Tarik) atau Usability Compliance (Kepatuhan Aturan)?^{*}

- Attractiveness (Daya Tarik)
- Usability Compliance (Kepatuhan Aturan)
- Sama Penting

Seberapa penting?^{*}

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Sub Karakteristik Efficiency

- Time Behaviour (Respon Waktu):

Kemampuan perangkat lunak dalam memberikan respon dan waktu pengolahan yang sesuai saat melakukan fungsinya.

- Resource Utilization (Pemanfaatan Sumber Daya):

Kemampuan perangkat lunak dalam menggunakan sumber daya yang dimilikinya ketika melakukan fungsi yang ditentukan.

- Efficiency Compliance (Kepatuhan Aturan):

Kemampuan perangkat lunak dalam memenuhi standar dan kebutuhan sesuai peraturan yang berlaku dengan efisiensi.

SKALA pada setiap pernyataan-pernyataan:

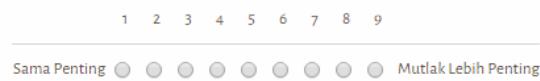
- 1 = Kedua Elemen SAMA PENTING
3 = Elemen ke-1 SEDIKIT LEBIH PENTING daripada Elemen ke-2
5 = Elemen ke-1 LEBIH PENTING daripada Elemen ke-2
7 = Elemen ke-1 SANGAT LEBIH PENTING daripada Elemen ke-2
9 = Elemen ke-1 MUTLAK LEBIH PENTING daripada Elemen ke-2
2, 4, 6, 8 = Nilai ini diberikan jika ada 2 Elemen DIANTARA 2 Pilihan

Menurut Anda, faktor mana yang lebih penting? Time Behaviour (Respon Waktu) atau Resource Utilization (Pemanfaatan Sumber Daya)?

- Time Behaviour (Respon Waktu)
 - Resource Utilization (Pemanfaatan Sumber Daya)
 - Sama Penting

Seberapa penting? ✎

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)



Menurut Anda, faktor mana yang lebih penting? Time Behaviour (Respon Waktu) atau Efficiency Compliance (Kepatuhan Aturan)?⁺

- Time Behaviour (Respon Waktu)
 - Efficiency Compliance (Kepatuhan Aturan)
 - Sama Penting

Seberapa penting? *

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)



Menurut Anda, faktor mana yang lebih penting? Resource Utilization (Pemanfaatan Sumber Daya) atau Efficiency Compliance (Kepatuhan Aturan)?¹⁰

- Resource Utilization (Pemanfaatan Sumber Daya)
 - Efficiency Compliance (Kepatuhan Aturan)
 - Sama Penting

Seberapa penting? *

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)



Sub Karakteristik Maintainability (Pemeliharaan)

- Analyzability (Diagnosis Kegagalan):

Kemampuan perangkat lunak dalam mendiagnosis kekurangan atau penyebab kegagalan.

- Maintainability Compliance (Kepatuhan Aturan):

Kemampuan perangkat lunak dalam memenuhi standar dan kebutuhan sesuai peraturan yang berlaku dengan pemeliharaan/perawatan.

SKALA pada setiap pernyataan-pernyataan:

- 1 = Kedua Elemen SAMA PENTING
- 3 = Elemen ke-1 SEDIKIT LEBIH PENTING daripada Elemen ke-2
- 5 = Elemen ke-1 LEBIH PENTING daripada Elemen ke-2
- 7 = Elemen ke-1 SANGAT LEBIH PENTING daripada Elemen ke-2
- 9 = Elemen ke-1 MUTLAK LEBIH PENTING daripada Elemen ke-2
- 2, 4, 6, 8 = Nilai ini diberikan jika ada 2 Elemen DIANTARA 2 Pilihan

Menurut Anda, faktor mana yang lebih penting? Analyzability (Diagnosis Kegagalan) atau Maintainability Compliance (Kepatuhan Aturan)?*

- Analyzability (Diagnosis Kegagalan)
- Maintainability Compliance (Kepatuhan Aturan)
- Sama Penting

Seberapa penting?*

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)



Sub Karakteristik Portability

- Adaptability (Adaptasi):

Kemampuan perangkat lunak untuk diadaptasikan pada lingkungan yang berbeda-beda.

- Installability (Proses Instalasi):

Kemampuan perangkat lunak untuk diinstal dalam lingkungan yang berbeda-beda.

- Coexistence:

Kemampuan perangkat lunak untuk berdampingan dengan perangkat lunak lainnya dalam satu lingkungan dengan berbagai sumber daya.

- Replaceability:

Kemampuan perangkat lunak untuk digunakan sebagai pengganti perangkat lunak lainnya.

- Portability Compliance (Kepatuhan Aturan):

Kemampuan perangkat lunak dalam memenuhi standar dan kebutuhan sesuai peraturan yang berlaku dengan portabilitas.

SKALA pada setiap pernyataan-pernyataan:

- 1 = Kedua Elemen SAMA PENTING
- 3 = Elemen ke-1 SEDIKIT LEBIH PENTING daripada Elemen ke-2
- 5 = Elemen ke-1 LEBIH PENTING daripada Elemen ke-2
- 7 = Elemen ke-1 SANGAT LEBIH PENTING daripada Elemen ke-2
- 9 = Elemen ke-1 MUTLAK LEBIH PENTING daripada Elemen ke-2
- 2, 4, 6, 8 = Nilai ini diberikan jika ada 2 Elemen DIANTARA 2 Pilihan

Menurut Anda, faktor mana yang lebih penting? Adaptability (Adaptasi) atau Installability (Proses Instalasi)?^{*}

- Adaptability (Adaptasi)
- Installability (Proses Instalasi)
- Sama Penting

Seberapa penting?^{*}

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Adaptability (Adaptasi) atau Coexistence?^{*}

- Adaptability (Adaptasi)
- Coexistence
- Sama Penting

Seberapa penting?^{*}

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Adaptability (Adaptasi) atau Replaceability?^{*}

- Adaptability (Adaptasi)
- Replaceability
- Sama Penting

Seberapa penting?^{*}

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Seberapa penting?^{*}

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Installability (Proses Instalasi) atau Coexistence?^{*}

- Installability (Proses Instalasi)
- Coexistence
- Sama Penting

Seberapa penting?^{*}

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)

1 2 3 4 5 6 7 8 9

Sama Penting Mutlak Lebih Penting

Menurut Anda, faktor mana yang lebih penting? Installability (Proses Instalasi) atau Replaceability?

- Installability (Proses Instalasi)
 - Replaceability
 - Sama Penting

Seberapa penting? *

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)



Menurut Anda, faktor mana yang lebih penting? Installability (Proses Instalasi) atau Portability Compliance (Kepatuhan Aturan)? *

- Installability (Proses Instalasi)
 - Portability Compliance (Kepatuhan Aturan)
 - Sama Penting

Seberapa penting? *

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)



Menurut Anda, faktor mana yang lebih penting? Coexistence atau Replaceability?

- Coexistence
 - Replaceability
 - Sama Penting

Seberapa penting?

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)



Menurut Anda, faktor mana yang lebih penting? Coexistence atau Portability Compliance (Kepatuhan Aturan)?¹

- Coexistence
 - Portability Compliance (Kepatuhan Aturan)
 - Sama Penting

Seberapa penting? *

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)



Menurut Anda, faktor mana yang lebih penting? Replaceability atau Portability Compliance (Kepatuhan Aturan)?*

- Replaceability
 - Portability Compliance (Kepatuhan Aturan)
 - Sama Penting

Seberapa penting? *

(Semakin ke kanan, semakin penting. Jika Anda memilih Sama Penting, pilih 1)



Appendix 2. Usage Quality Questionnaire of BBM, WhatsApp, and LINE Application



Kuesioner Kualitas Penggunaan Aplikasi BlackBerry Messenger (BBM), WhatsApp, dan LINE pada Smartphone Berbasis Android

Assalamu'alaikum Wr. Wb.

Sehubungan dengan adanya penelitian yang berjudul "Pengukuran Kualitas Aplikasi Instant Messenger Terpopuler di Indonesia pada Smartphone Berbasis Android" untuk penyelesaian tugas akhir. Bersama ini saya:

Nama : Nur Fisabilillah

Jurusan : Magister Sistem Informasi Bisnis, Universitas Gunadarma

Dengan segala kerendahan hati, memohon bantuan Anda yang menggunakan ketiga aplikasi instant messenger (Blackberry Messenger (BBM), WhatsApp Messenger, dan LINE Messenger) pada smartphone berbasis Android untuk mengisi angket ini. Jawaban yang Anda berikan semua adalah benar, tidak ada jawaban yang salah. Pastikan tidak ada jawaban yang kosong atau terlewatkan. Kerahasiaan atas data dan jawaban Anda akan dijamin oleh peneliti.

Atas ketersedian Anda untuk mengisi kuesioner ini, saya ucapkan terima kasih.
Wassalamu'alaikum Wr. Wb.

Hormat saya,

Peneliti
(Nur Fisabilillah)

^a Wajib

IDENTITAS RESPONDEN

Nama Lengkap *

Jenis Kelamin *

Usia *

No Handphone

Opsional untuk undian hadiah pulsa elektrik

Kab/Kota Tinggal Anda saat ini*

Misal. Kota Bekasi

Merk dan Tipe HP Anda*

Misal. Samsung Grand 2 SM-G7102

Versi Android HP Anda*
 ▾
KUALITAS APLIKASI INSTANT MESSENGER

Pernyataan-pernyataan di bawah ini berkaitan dengan persepsi Anda terhadap kualitas aplikasi BlackBerry Messenger (BBM), WhatsApp Messenger, dan LINE Messenger pada smartphone Anda. Berikut adalah skala pada setiap pernyataan-pernyataan dalam mengisi kuesioner ini.

STS = Sangat Tidak Setuju

TS = Tidak Setuju

N = Netral

S = Setuju

SS = Sangat Setuju

A. Mudah Dimengerti (Understandability)

Secara keseluruhan, saya merasa puas dengan kemudahan penggunaan aplikasi instant messenger:*

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

Cara penggunaan sangat simple pada aplikasi instant messenger:*

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

Informasi yang diberikan sangat mudah dipahami pada aplikasi instant messenger:*

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

B. Mudah Dipelajari (Learnability)

Saya merasa sangat mudah mempelajari aplikasi instant messenger: *

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

Informasi yang disediakan sangat jelas pada aplikasi instant messenger: *

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

C. Operabilitas (Operability)

Jika terjadi error, pesan pemberitahuan tentang langkah yang harus saya lakukan untuk mengatasi masalah tersebut akan muncul pada aplikasi instant messenger: *

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

Saya bisa kembali dan berkomunikasi lagi (pulih) dengan cepat saat saya melakukan kesalahan pada aplikasi instant messenger: *

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

Mudah untuk memperoleh informasi yang saya butuhkan dengan menggunakan aplikasi instant messenger: *

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

Informasi yang diperoleh saat berkomunikasi sangat efektif dalam membantu menyelesaikan pekerjaan saya dengan menggunakan aplikasi instant messenger: *

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

D. Daya Tarik (Attractiveness)

Saya merasa nyaman menggunakan aplikasi instant messenger: *

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

Tata letak informasi yang terdapat di layar monitor sangat jelas pada aplikasi instant messenger: *

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

Tampilan aplikasi instant messenger ini sangat memudahkan: *

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

Saya suka menggunakan tampilan semacam aplikasi instant messenger: *

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

E. Kepatuhan (Usability Compliance)

Saya dapat berkomunikasi dengan efektif ketika menggunakan aplikasi instant messenger:^a

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

Saya dapat dengan cepat berkomunikasi menggunakan aplikasi instant messenger:^a

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

Saya dapat berkomunikasi dengan efisien ketika menggunakan aplikasi instant messenger:^a

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

Saya yakin bahwa saya akan lebih produktif ketika menggunakan aplikasi instant messenger:^a

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

Semua fungsi dan kapabilitas yang saya perlukan telah tersedia pada aplikasi instant messenger:^a

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

Secara keseluruhan, saya sangat puas dengan kinerja aplikasi instant messenger:^a

	STS	TS	N	S	SS
BlackBerry Messenger	<input type="radio"/>				
WhatsApp	<input type="radio"/>				
LINE	<input type="radio"/>				

**Appendix 3. Results Statistics Validity & Reliability Test of Weight Determination
Questionnaire**

```
CORRELATIONS
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/PRINT=TWOTAIL NOSIG
/MISSING=PAIRWISE.
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Correlations

Notes			
Output Created			24-MAR-2015 21:39:50
Comments			
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		Filter	<none>
		Weight	<none>
		Split File	<none>
		N of Rows in Working Data File	204
		Definition of Missing	User-defined missing values are treated as missing.
Handling	Missing	Value	Statistics for each pair of variables are based on all the cases with valid data for that pair.
		Cases Used	
Syntax			CORRELATIONS /VARIABLES=UB01 UW01 UL01 UB02 UW02 UL02 UB03 UW03 UL03 TU /PRINT=TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources		Processor Time	00:00:00.02
		Elapsed Time	00:00:00.04

[DataSet0]

Correlations

		U	U	U	U	U	U
		B01	W01	L01	B02	W02	L02
	Pearson Correlation	1	.5 37**	.5 .0	.6 12**	.4 89**	.4 22**
B01	l Sig. (2-tailed)		.00	.00	.00	.00	.00
	N	20	20	20	20	20	20
		4	4	4	4	4	4
	Pearson Correlation	.5 37**	1	.5 13**	.4 30**	.7 30**	.4 80**
W01	l Sig. (2-tailed)	.0 .00		.0 00	.0 00	.0 00	.0 00
	N	20	20	20	20	20	20
		4	4	4	4	4	4
	Pearson Correlation	.5 12**	.5 13**	1	.4 54**	.3 86**	.6 90**
L01	l Sig. (2-tailed)	.0 .00	.0 00		.0 00	.0 00	.0 00
	N	20	20	20	20	20	20
		4	4	4	4	4	4
	Pearson Correlation	.6 89**	.4 30**	.4 54**	1 1	.4 46**	.4 77**
B02	l Sig. (2-tailed)	.0 .00	.0 00	.0 00		.0 00	.0 00
	N	20	20	20	20	20	20
		4	4	4	4	4	4
	Pearson Correlation	.4 22**	.7 30**	.3 86**	.4 46**	.5 1	.4 45**
W02	l Sig. (2-tailed)	.0 .00	.0 00	.0 00	.0 00		.0 00
	N	20	20	20	20	20	20
		4	4	4	4	4	4
	Pearson Correlation	.4 05**	.4 80**	.6 90**	.4 77**	.5 45**	1
L02	l Sig. (2-tailed)	.0 .00	.0 00	.0 00	.0 00	.0 00	

		N	20	20	20	20	20	20
		4	4	4	4	4	4	4
		Pearson	.6	.4	.4	.6	.4	.4
		Correlation	56**	41**	44**	21**	68**	13**
B03	L	Sig. (2-tailed)	.0	.0	.0	.0	.0	.0
		00	00	00	00	00	00	00
		N	20	20	20	20	20	20
		4	4	4	4	4	4	4
		Pearson	.4	.6	.3	.3	.7	.4
		Correlation	19**	79**	79**	65**	29**	63**
W03	L	Sig. (2-tailed)	.0	.0	.0	.0	.0	.0
		00	00	00	00	00	00	00
		N	20	20	20	20	20	20
		4	4	4	4	4	4	4
		Pearson	.4	.4	.6	.3	.4	.6
		Correlation	00**	87**	40**	50**	22**	81**
L03	L	Sig. (2-tailed)	.0	.0	.0	.0	.0	.0
		00	00	00	00	00	00	00
		N	20	20	20	20	20	20
		4	4	4	4	4	4	4
		Pearson	.7	.7	.7	.7	.7	.7
		Correlation	53**	71**	47**	21**	46**	64**
U	T	Sig. (2-tailed)	.0	.0	.0	.0	.0	.0
		00	00	00	00	00	00	00
		N	20	20	20	20	20	20
		4	4	4	4	4	4	4

Correlations

		UB03	UW03	UL03	TU	
B01	U	Pearson Correlation	.656	.419**	.400**	.753**
		Sig. (2-tailed)	.000	.000	.000	.000
		N	204	204	204	204
W01	U	Pearson Correlation	.441**	.679	.487**	.771**
		Sig. (2-tailed)	.000	.000	.000	.000
		N	204	204	204	204
	U	Pearson Correlation	.444**	.379**	.640	.747**

L01		Sig. (2-tailed)	.000	.000	.000	.000
		N	204	204	204	204
B02	U	Pearson Correlation	.621**	.365**	.350**	.721
		Sig. (2-tailed)	.000	.000	.000	.000
W02	U	N	204	204	204	204
		Pearson Correlation	.468**	.729**	.422**	.746**
L02	U	Sig. (2-tailed)	.000	.000	.000	.000
		N	204	204	204	204
B03	U	Pearson Correlation	.413**	.463**	.681**	.764**
		Sig. (2-tailed)	.000	.000	.000	.000
W03	U	N	204	204	204	204
		Pearson Correlation	1**	.610**	.514**	.766**
L03	U	Sig. (2-tailed)	.000	.000	.000	.000
		N	204	204	204	204
T	U	Pearson Correlation	.610**	1**	.595**	.760**
		Sig. (2-tailed)	.000	.000	.000	.000
U	U	N	204	204	204	204
		Pearson Correlation	.514**	.595**	1**	.751**
L03	U	Sig. (2-tailed)	.000	.000	.000	.000
		N	204	204	204	204
T	U	Pearson Correlation	.766**	.760**	.751**	1**
		Sig. (2-tailed)	.000	.000	.000	.000
U	U	N	204	204	204	204

**. Correlation is significant at the 0.01 level (2-tailed).

```
RELIABILITY
/VARIABLES=UB01 UW01 UL01 UB02 UW02 UL02 UB03 UW03 UL03 TU
/SCALE('ALL VARIABLES') ALL
/MODEL=ALPHA.
```

Reliability

Notes

Output Created	24-MAR-2015 21:56:09	
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>

		Split File	<none>
		N of Rows in Working Data File	204
		Matrix Input	
		Definition of Missing	User-defined missing values are treated as missing.
Handling	Missing	Value	Statistics are based on all cases with valid data for all variables in the procedure.
		Cases Used	
Syntax			RELIABILITY /VARIABLES=UB01 UW01 UL01 UB02 UW02 UL02 UB03 UW03 UL03 TU /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.
Resources		Processor Time	00:00:00.02
		Elapsed Time	00:00:00.02

[DataSet0]

Scale: ALL VARIABLES

Case Processing Summary

		N	%
	Valid	204	100. 0
Cases	Excluded ^a	0	.0
	Total	204	100. 0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.779	10

```
CORRELATIONS
/VARIABLES=LB01 LW01 LL01 LB02 LW02 LL02 TL
/PRINT=TWOTAIL NOSIG
/MISSING=PAIRWISE.
```

Correlations

Notes					
Output Created					24-MAR-2015 22:01:06
Comments					
		Active Dataset		DataSet0	
		Filter		<none>	
Input		Weight		<none>	
		Split File		<none>	
		N of Rows in Working Data File		204	
		Definition of Missing		User-defined missing values are treated as missing.	
Missing		Value		Statistics for each pair of variables are based on all the cases with valid data for that pair.	
Handling		Cases Used			
Syntax				CORRELATIONS /VARIABLES=LB01 LW01 LL01 LB02 LW02 LL02 TL /PRINT=TWOTAIL NOSIG /MISSING=PAIRWISE.	
Resources		Processor Time		00:00:00.03	
		Elapsed Time		00:00:00.03	

[DataSet0]

Correlations

		L	L	L	L	L	L
		B01	W01	L01	B02	W02	L02
B01	Pearson Correlation	1	.5 41**	.5 86**	.6 23**	.3 21**	.3 73**
	Sig. (2-tailed)		.0 00	.0 00	.0 00	.0 00	.0 00

		N	2	2	2	2	2
		Pearson	.	.04	.04	.04	.04
		Correlation	541**	1	.5	.4	.5
		Sig. (2-tailed)	.	.000	.0	.0	.0
W01		N	2	2	2	2	2
		Pearson	.	.04	.04	.04	.04
L01		Correlation	586**	85**	1	.08**	.27**
		Sig. (2-tailed)	.	.000	.0	.0	.0
B02		N	2	2	2	2	2
		Pearson	.	.04	.04	.04	.04
W02		Correlation	623**	24**	.08**	1	.39**
		Sig. (2-tailed)	.	.000	.0	.0	.0
L02		N	2	2	2	2	2
		Pearson	.	.04	.04	.04	.04
L		Correlation	321**	93**	.27**	.39**	.82**
		Sig. (2-tailed)	.	.000	.0	.0	.0
		N	2	2	2	2	2
		Pearson	.	.04	.04	.04	.04
		Correlation	373**	46**	.46**	.48**	.82**
		Sig. (2-tailed)	.	.000	.0	.0	.0
		N	2	2	2	2	2
		Pearson	.	.04	.04	.04	.04
		Correlation	764**	66**	.77**	.95**	.31**
		Sig. (2-tailed)	.	.000	.0	.0	.0
		N	2	2	2	2	2
		Pearson	.	.04	.04	.04	.04

Correlations		TL
	Pearson Correlation	.764
LB01	Sig. (2-tailed)	.000
	N	204
	Pearson Correlation	.766**
LW01	Sig. (2-tailed)	.000
	N	204
	Pearson Correlation	.777**
LL01	Sig. (2-tailed)	.000
	N	204
	Pearson Correlation	.795**
LB02	Sig. (2-tailed)	.000
	N	204
	Pearson Correlation	.731**
LW02	Sig. (2-tailed)	.000
	N	204
	Pearson Correlation	.777**
LL02	Sig. (2-tailed)	.000
	N	204
	Pearson Correlation	1**
TL	Sig. (2-tailed)	
	N	204

**. Correlation is significant at the 0.01 level (2-tailed).

```
RELIABILITY
/VARIABLES=LB01 LW01 LL01 LB02 LW02 LL02 TL
/SCALE('ALL VARIABLES') ALL
/MODEL=ALPHA.
```

Reliability

Notes		
Output Created		24-MAR-2015 22:05:48
Comments		
Input	Active Dataset Filter	DataSet0 <none>

		Weight	<none>
		Split File	<none>
		N of Rows in Working Data File	204
		Matrix Input	
		Definition of Missing	User-defined missing values are treated as missing.
Handling	Missing	Value	Statistics are based on all cases with valid data for all variables in the procedure.
		Cases Used	
Syntax			RELIABILITY /VARIABLES=LB01 LW01 LL01 LB02 LW02 LL02 TL /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.
Resources		Processor Time	00:00:00.03
		Elapsed Time	00:00:00.01

[DataSet0]

Scale: ALL VARIABLES

Case Processing Summary

		N	%
	Valid	204	100. 0
Cases	Excl ded ^a	0	.0
	Total	204	100. 0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.792	7

Appendix 4. Results Statistics Validity & Reliability Test of Usage Quality
 Questionnaire

```
CORRELATIONS
/VARIABLES=UB01 UW01 UL01 UB02 UW02 UL02 UB03 UW03 UL03 TU
/PRINT=TWOTAIL NOSIG
/MISSING=PAIRWISE.
```

Correlations

		Notes
Output Created		24-MAR-2015 21:39:50
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	204
Handling	Definition of Missing	User-defined missing values are treated as missing.
Missing	Value	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax	Cases Used	
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.04

[DataSet0]

		Correlations					
		U	U	U	U	U	U
		B01	W01	L01	B02	W02	L02
B01	Pearson Correlation	1	.5	.5	.6	.4	.4
	l Sig. (2-tailed)		.00	.00	.00	.00	.00
	N	20	20	20	20	20	20
		4	4	4	4	4	4
	Pearson Correlation	.5	1	.5	.4	.7	.4
	l Sig. (2-tailed)	.00		.00	.00	.00	.00
W01	N	20	20	20	20	20	20
		4	4	4	4	4	4
	Pearson Correlation	.5	.5	1	.4	.3	.6
	l Sig. (2-tailed)	.00	.00		.00	.00	.00
	N	20	20	20	20	20	20
		4	4	4	4	4	4
L01	Pearson Correlation	.5	.5	1	.4	.3	.6
	l Sig. (2-tailed)	.00	.00		.00	.00	.00
	N	20	20	20	20	20	20
		4	4	4	4	4	4
	Pearson Correlation	.6	.4	.4	1	.4	.4
	l Sig. (2-tailed)	.00	.00	.00		.00	.00
B02	N	20	20	20	20	20	20
		4	4	4	4	4	4
	Pearson Correlation	.6	.4	.4	1	.4	.4
	l Sig. (2-tailed)	.00	.00	.00		.00	.00
	N	20	20	20	20	20	20
		4	4	4	4	4	4
W02	Pearson Correlation	.4	.7	.3	.4	1	.5
	l Sig. (2-tailed)	.00	.00	.00	.00		.00
	N	20	20	20	20	20	20
		4	4	4	4	4	4
	Pearson Correlation	.4	.4	.6	.4	.5	1
	l Sig. (2-tailed)	.00	.00	.00	.00	.00	
L02	N	20	20	20	20	20	20
		4	4	4	4	4	4

	Pearson	.6	.4	.4	.6	.4	.4
	Correlation	56**	41**	44**	21**	68**	13**
B03	L Sig. (2-tailed)	.000	.000	.000	.000	.000	.000
	N	204	204	204	204	204	204
	Pearson	.4	.6	.3	.3	.7	.4
	Correlation	19**	79**	79**	65**	29**	63**
W03	L Sig. (2-tailed)	.000	.000	.000	.000	.000	.000
	N	204	204	204	204	204	204
	Pearson	.4	.4	.6	.3	.4	.6
	Correlation	00**	87**	40**	50**	22**	81**
L03	L Sig. (2-tailed)	.000	.000	.000	.000	.000	.000
	N	204	204	204	204	204	204
	Pearson	.7	.7	.7	.7	.7	.7
	Correlation	53**	71**	47**	21**	46**	64**
U	T Sig. (2-tailed)	.000	.000	.000	.000	.000	.000
	N	204	204	204	204	204	204
		4	4	4	4	4	4

Correlations

		UB03	UW03	UL03	TU
B01	U Pearson Correlation	.656	.419**	.400**	.753**
	U Sig. (2-tailed)	.000	.000	.000	.000
	N	204	204	204	204
W01	U Pearson Correlation	.441**	.679	.487**	.771**
	U Sig. (2-tailed)	.000	.000	.000	.000
	N	204	204	204	204
L01	U Pearson Correlation	.444**	.379**	.640	.747**
	U Sig. (2-tailed)	.000	.000	.000	.000
	N	204	204	204	204

		Pearson Correlation	.621**	.365**	.350**	.721
B02	U	Sig. (2-tailed)	.000	.000	.000	.000
		N	204	204	204	204
	U	Pearson Correlation	.468**	.729**	.422**	.746**
W02	U	Sig. (2-tailed)	.000	.000	.000	.000
		N	204	204	204	204
	U	Pearson Correlation	.413**	.463**	.681**	.764**
L02	U	Sig. (2-tailed)	.000	.000	.000	.000
		N	204	204	204	204
	U	Pearson Correlation	1**	.610**	.514**	.766**
B03	U	Sig. (2-tailed)		.000	.000	.000
		N	204	204	204	204
	U	Pearson Correlation	.610**	1**	.595**	.760**
W03	U	Sig. (2-tailed)	.000		.000	.000
		N	204	204	204	204
	U	Pearson Correlation	.514**	.595**	1**	.751**
L03	U	Sig. (2-tailed)	.000	.000		.000
		N	204	204	204	204
	T	Pearson Correlation	.766**	.760**	.751**	1**
U	T	Sig. (2-tailed)	.000	.000	.000	
		N	204	204	204	204

**. Correlation is significant at the 0.01 level (2-tailed).

```
RELIABILITY
/VARIABLES=UB01 UW01 UL01 UB02 UW02 UL02 UB03 UW03 UL03 TU
/SCALE ('ALL VARIABLES') ALL
/MODEL=ALPHA.
```

Reliability

Notes

Output Created		24-MAR-2015 21:56:09
Comments		
	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
Input	N of Rows in Working Data File	204

		Matrix Input	
		Definition of Missing	User-defined missing values are treated as missing.
Handling	Missing	Value	Statistics are based on all cases with valid data for all variables in the procedure.
		Cases Used	
Syntax			RELIABILITY /VARIABLES=UB01 UW01 UL01 UB02 UW02 UL02 UB03 UW03 UL03 TU /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.
Resources		Processor Time	00:00:00.02
		Elapsed Time	00:00:00.02

[DataSet0]

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	204	100. 0
	Excl ded ^a	0	.0
	Total	204	100. 0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.779	10

```
CORRELATIONS
/VARIABLES=LB01 LW01 LL01 LB02 LW02 LL02 TL
/PRINT=TWOTAIL NOSIG
/MISSING=PAIRWISE.
```

Correlations

Notes					
Output Created					24-MAR-2015 22:01:06
Comments					
		Active Dataset		DataSet0	
		Filter		<none>	
Input		Weight		<none>	
		Split File		<none>	
		N of Rows in Working Data File		204	
		Definition of Missing		User-defined missing values are treated as missing.	
Missing		Value		Statistics for each pair of variables are based on all the cases with valid data for that pair.	
Handling		Cases Used			
Syntax				CORRELATIONS /VARIABLES=LB01 LW01 LL01 LB02 LW02 LL02 TL /PRINT=TWOTAIL NOSIG /MISSING=PAIRWISE.	
Resources		Processor Time		00:00:00.03	
		Elapsed Time		00:00:00.03	

[DataSet0]

Correlations

		L	L	L	L	L	L
		B01	W01	L01	B02	W02	L02
B01	Pearson Correlation	1	.5 41**	.5 86**	.6 23**	.3 21**	.3 73**
	Sig. (2-tailed)		.0 00	.0 00	.0 00	.0 00	.0 00

		Correlations						
		N	2	2	2	2	2	
		Pearson	.		.5	.4	.5	.4
		Correlation	541**	1	85**	24**	93**	46**
		Sig. (2-tailed)	.		.0	.0	.0	.0
W01	N	000		00	00	00	00	
	Pearson	.		.0	.0	.0	.0	
L01	N	04	04	04	04	04	04	
	Pearson	.	.5	1	.4	.3	.6	
B02	Correlation	586**	85**		08**	27**	46**	
	Sig. (2-tailed)	.	.0		.0	.0	.0	
W02	000		00		00	00	00	
	N	04	04	04	04	04	04	
L02	Pearson	.	.4	.4		.6	.5	
	Correlation	623**	24**	08**	1	39**	48**	
L	Sig. (2-tailed)	.	.0	.0		.0	.0	
	000		00	00		00	00	
W01	N	04	04	04	04	04	04	
	Pearson	.	.5	.3	.6		.5	
L01	Correlation	321**	93**	27**	39**		82**	
	Sig. (2-tailed)	.	.0	.0	.0		.0	
B02	000		00	00	00		00	
	N	04	04	04	04	04	04	
W02	Pearson	.	.5	.3	.6		.5	
	Correlation	373**	46**	46**	48**	82**		
L02	Sig. (2-tailed)	.	.0	.0	.0		.0	
	000		00	00	00		00	
L	N	04	04	04	04	04	04	
	Pearson	.	.7	.7	.7	.7	.7	
W01	Correlation	764**	66**	77**	95**	31**	77**	
	Sig. (2-tailed)	.	.0	.0	.0	.0	.0	
L01	000		00	00	00	00	00	
	N	04	04	04	04	04	04	

Correlations

		TL
	Pearson Correlation	.764
LB01	Sig. (2-tailed)	.000
	N	204
	Pearson Correlation	.766**
LW01	Sig. (2-tailed)	.000
	N	204
	Pearson Correlation	.777**
LL01	Sig. (2-tailed)	.000
	N	204
	Pearson Correlation	.795**
LB02	Sig. (2-tailed)	.000
	N	204
	Pearson Correlation	.731**
LW02	Sig. (2-tailed)	.000
	N	204
	Pearson Correlation	.777**
LL02	Sig. (2-tailed)	.000
	N	204
	Pearson Correlation	1**
TL	Sig. (2-tailed)	
	N	204

**. Correlation is significant at the 0.01 level (2-tailed).

```
RELIABILITY
/VARIABLES=LB01 LW01 LL01 LB02 LW02 LL02 TL
/SCALE ('ALL VARIABLES') ALL
/MODEL=ALPHA.
```

Reliability

Notes		
Output Created		24-MAR-2015 22:05:48
Comments		
	Active Dataset	DataSet0
Input	Filter	<none>
	Weight	<none>
	Split File	<none>

		N of Rows in Working Data File	204
		Matrix Input	
		Definition of Missing	User-defined missing values are treated as missing.
Handling	Missing	Value	Statistics are based on all cases with valid data for all variables in the procedure.
		Cases Used	
Syntax			RELIABILITY /VARIABLES=LB01 LW01 LL01 LB02 LW02 LL02 TL /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.
Resources		Processor Time	00:00:00.03
		Elapsed Time	00:00:00.01

[DataSet0]

Scale: ALL VARIABLES

Case Processing Summary

		N	%
	Valid	204	100. 0
Cases	Exclu ded ^a	0	.0
	Total	204	100. 0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.792	7

Appendix 5. Tabel r Product Moment

Nilai-Nilai r Product Moment

N	Taraf Signif		N	Taraf Signif		N	Taraf Signif	
	5%	1%		5%	1%		5%	1%
3	0,997	0,999	27	0,381	0,487	55	0,266	0,345
4	0,95	0,99	28	0,374	0,478	60	0,254	0,33
5	0,878	0,959	29	0,367	0,47	65	0,244	0,317
6	0,811	0,917	30	0,361	0,463	70	0,235	0,306
7	0,754	0,874	31	0,355	0,456	75	0,227	0,296
8	0,707	0,834	32	0,349	0,449	80	0,22	0,286
9	0,666	0,798	33	0,344	0,442	85	0,213	0,278
10	0,632	0,765	34	0,339	0,436	90	0,207	0,27
11	0,602	0,735	35	0,334	0,43	95	0,202	0,263
12	0,576	0,708	36	0,329	0,424	100	0,195	0,256
13	0,553	0,684	37	0,325	0,418	125	0,176	0,23
14	0,532	0,661	38	0,32	0,413	150	0,159	0,21
15	0,514	0,641	39	0,316	0,408	175	0,148	0,194
16	0,497	0,623	40	0,312	0,403	200	0,138	0,181
17	0,482	0,606	41	0,308	0,398	300	0,113	0,148
18	0,468	0,59	42	0,304	0,393	400	0,098	0,128
19	0,456	0,575	43	0,301	0,389	500	0,088	0,115
20	0,444	0,561	44	0,297	0,384	600	0,08	0,105
21	0,433	0,549	45	0,294	0,38	700	0,074	0,097
22	0,423	0,537	46	0,291	0,376	800	0,07	0,091
23	0,413	0,526	47	0,288	0,372	900	0,065	0,086
24	0,404	0,515	48	0,284	0,368	1000	0,062	0,081
25	0,396	0,505	49	0,281	0,364			
26	0,388	0,496	50	0,279	0,361			